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POLYZOA (BRYOZOA)

I. SCRUPOCELLARIIDAE, EPISTOMIIDAE, FARCIMINARIIDAE,  
BICELLARIELLIDAE, AETEIDAE, SCRUPARIIDAE

By

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(Plates V-XIII; Text-figs. 1-66)

### INTRODUCTION

IN the course of the Discovery Investigations an exceptionally fine collection of Antarctic and sub-Antarctic Polyzoa has been made, as well as small collections from South Africa, New Zealand and certain islands in the tropical Atlantic. Together with this Discovery material I have studied the collections made by the National Antarctic Expedition (1901-4) and the British Antarctic ('Terra Nova') Expedition;<sup>1</sup> the South Georgian Polyzoa collected by the Shackleton-Rowett ('Quest') Expedition; and collections from the Falkland Islands lent to me by the Hamburg Museum and the U.S. National Museum.

British Museum specimens are designated throughout by their registration numbers which consist of four numbers separated by full stops, thus: 87.12.9.166, or 1938.3.5.1.

Six families are considered in this report. They comprise eighty Antarctic and sub-Antarctic species with fifteen varieties (see Table 3, p. 479). The only species in Table 3 that I have not had an opportunity of examining are six of the abyssal forms. A list of the species collected by the Discovery and the Terra Nova Expeditions at localities outside the Antarctic and sub-Antarctic area is given on p. 491. A list of the species discussed in the systematic part of the report is given on p. 318, and on p. 305 a list of species obtained at each Discovery station.

The inclusion of the Scrupariidae is for convenience, and is not meant to imply that I regard the problem of whether they belong to the Cellularina or the Malacostega as settled (cf. Harmer, 1926, p. 187). I have no doubt that *Brettia triplex* belongs to the Cellularina, but its relationship to the other species of *Brettia* is uncertain.

### INTERPRETATION OF BUSK'S WORK

It should perhaps be explained that Busk's original drawings have recently come into my hands, and, as many of them have unpublished data written on them, they are useful in interpreting his work.

In the past the scanty explanations published with Busk's figures have been a great difficulty. A species would be recorded from several more or less remote localities, and

<sup>1</sup> Anyone re-examining the Terra Nova material should be warned that some specimens have a false appearance of pigmentation because they have spent many years in jars of mixed material which included animals whose pigment has dissolved in the spirit and stained the whole contents of the jars.

figured without any statement of the origin of the figured specimen. The British Museum Catalogue (1852 and 1854) has given especial difficulty in this way. There is in the Museum a series of slides, received in 1854 and known as the "British Museum Catalogue Collection", but only a small part of the specimens mentioned in the catalogue is represented in this collection, and the rest have been regarded as missing or unrecognizable. The drawings show that the catalogue was, as its name implies, chiefly based on specimens already in the Museum, including the Johnston collection (catalogued by Gray, 1848), whose registered numbers are given on many of the drawings. The slides received in 1854 are specimens from Busk's own collection which he included in the catalogue and deposited in the Museum on its publication.

As to the *Challenger Reports*, the series of mounted and unmounted specimens received by the British Museum in 1887 and known as the "Challenger Collection" is almost complete in so far as specimens of each species from nearly every station at which it was recorded are present, but a large number of preparations from this material were kept by Busk and did not come to the Museum till his whole collection came in 1899. It has generally been assumed that the type and figured specimens were to be found among those deposited in 1887, but it is now known that there are some figured and otherwise important Challenger specimens in the 1899 collection.

The work of tracing the figured specimens and preparing a new set of more detailed explanations of Busk's figures is in progress. In the meantime some of the information has been used to solve the problems of the present report.

#### ACKNOWLEDGEMENTS

I am very grateful to Dr Thiel and Professor Bassler for the loans of unnamed material from the Hamburg and U.S. National Museums respectively, and for the exchange arrangements by which we have kept some of the material; to Dr Thiel for lending me some of Calvet's type specimens; to the Manchester Museum for frequent loans of type and other specimens from the Waters Collection; to Mr A. A. Livingstone, Professor Ernst Marcus, Professor C. H. O'Donoghue and Professor R. C. Osburn, who have all lent specimens of their own, and to Dr Sixten Bock for lending specimens from the Riksmuseum, Stockholm; to the Discovery Staff, most of whom have at one time or another given me the benefit of their special knowledge of the problems before me, particularly over questions of distribution and hydrology; to the Director of the Scott Polar Research Institute, Cambridge, for the facilities afforded me for consulting various documents, including notes made by Mr Hodgson, naturalist to the National Antarctic Expedition; to Mr W. A. Smith, from whom I have constantly received very reliable help, particularly in listing and sorting collections and checking manuscript and proofs; to Mr M. G. Sawyers for his careful and skilful photography; to Miss E. C. Humphreys for the clearness and accuracy of the maps; to Sir Sidney Harmer for opportunities of consulting his catalogue and for his interest and help throughout my work; and to Dr N. A. Mackintosh for his patience over my unavoidable delays with the proofs.

LIST OF STATIONS, AND OF THE SPECIES  
COLLECTED AT EACH

## DISCOVERY INVESTIGATIONS

Further particulars of the stations are given in the Discovery Investigations Station Lists:

- 1925-1927. Discovery Reports, I, 1929, pp. 1-140, pls. i-vi.  
 1927-1929. Discovery Reports, III, 1930, pp. 1-132, pls. i-x.  
 1929-1931. Discovery Reports, IV, 1932, pp. 1-232, pls. i-v.  
 1931-1933. Discovery Reports, XXI, 1941, pp. 1-226, pls. i-iv.

*R.R.S. 'Discovery'*

- St. 1. 16. xi. 25. Clarence Bay, Ascension Island, 7° 55' 15" S, 14° 25' W. 16-27 m.  
*Scrupocellaria frondis* Kirkpatrick *Aetea curta* Jullien
- St. 4. 30. i. 26. Tristan da Cunha, 36° 55' S, 12° 12' W. 40-46 m.  
*Scrupocellaria ornithorhyncus* Thomson *Aetea anguina* (Linnaeus)  
*Caberea rostrata* Busk
- St. 5. 31. i. 26. Quest Bay, Tristan da Cunha. 7-12 m.  
*Scrupocellaria ornithorhyncus* Thomson *Caberea rostrata* Busk
- St. 6. 1. ii. 26. Tristan da Cunha, 3 miles N 30° E of Settlement. 80-140 m.  
*Caberea darwinii* Busk *Cornucopina pectogemma* (Goldstein)
- St. 20. 4. iii. 26. South Georgia, 14.6 miles N 41° E of Cape Saunders. 200 m.  
*Himantozoum antarcticum* (Calvet)
- St. 27. 15. iii. 26. West Cumberland Bay, South Georgia, 3.3 miles S 44° E of Jason Light.  
 110 m.  
*Amastigia gaussi* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Notoplites drygalskii* (Kluge) *Camptoplites tricornis* Waters  
*Farciminellum antarcticum* sp.n. *C. retiformis* (Kluge)
- St. 39. 25. iii. 26. East Cumberland Bay, South Georgia, from 8 cables S 81° W of Merton Rock  
 to 1.3 miles N 7° E of Macmahon Rock. 179-235 m.  
*Amastigia gaussi* (Kluge) *Camptoplites bicornis* var. *magna* (Kluge)  
*Notoplites antarcticus* (Waters) *C. retiformis* (Kluge)  
*N. tenuis* (Kluge)
- St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia, from 6.3 miles N 89° E of Jason  
 Light to 4 miles N 39° E of Jason Light. 120-204 m.  
*Amastigia gaussi* (Kluge) *Cornucopina pectogemma* (Goldstein)  
*Notoplites antarcticus* (Waters) *Beania erecta* var. *livingstonei* var.n.  
*N. drygalskii* (Kluge) *Himantozoum antarcticum* (Calvet)  
*N. crassiscutus* sp.n. *Camptoplites tricornis* (Waters)  
*Caberea darwinii* Busk *C. retiformis* (Kluge)  
*Farciminellum antarcticum* sp.n.
- St. 45. 6. iv. 26. South Georgia, 2.7 miles S 85° E of Jason Light. 238-270 m.  
*Caberea darwinii* Busk *Camptoplites latus* var. *aspera* var.n.  
*Himantozoum antarcticum* (Calvet)
- St. 48. 3. v. 26. Port William, Falkland Islands, 8.3 miles N 53° E of William Point Beacon.  
 105-115 m.  
*Beania costata* (Busk)

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Island, from 7 miles N 50° E to 7.6 miles N 63° E of Eddystone Rock. 105-115 m.

*Notoplites elongatus* var. *calveti* var.n.

*Caberea darwinii* Busk

*Tricellaria aculeata* (d'Orbigny)

St. 53. 12. v. 26. Port Stanley, East Falkland Island, hulk of 'Great Britain'. 0-2 m.

*Tricellaria aculeata* (d'Orbigny)

St. 56. 16. v. 26. Sparrow Cove, Port William, East Falkland Island, 1½ cables N 50° E of Sparrow Point. 10½-16 m.

*Caberea darwinii* Busk

*Beania costata* (Busk)

St. 58. 19. v. 26. Port Stanley, East Falkland Island. 1-2 m.

*Beania magellanica* Busk

St. 91. 8. ix. 26. False Bay, South West Africa, 0.5 mile off Roman Rock. 35 m.

*Bugula calathus* Norman

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia, from 4.1 miles N 54° E of Larsen Point to 1.2 miles S 62° W of Merton Rock. 230-250 m.

*Notoplites drygalskii* (Kluge)

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia, from 54° 02' S, 36° 38' W to 54° 11' 30" S, 36° 29' W. 122-136 m.

*Amastigia gausi* (Kluge)

*Farciminellum antarcticum* sp.n.

*Notoplites drygalskii* (Kluge)

*Beania erecta* var. *livingstonei* var.n.

*Caberea darwinii* Busk

*Camptoplites latus* var. *aspera* var.n.

St. 144. 5. i. 27. Off mouth of Stromness Harbour, South Georgia, from 54° 04' S, 36° 27' W to 53° 58' S, 36° 26' W. 155-178 m.

*Notoplites drygalskii* (Kluge)

*Himantozoum antarcticum* (Calvet)

*Farciminellum antarcticum* sp.n.

St. 145. 7. i. 27. Stromness Harbour, South Georgia, between Grass Island and Tonsberg Point. 26-35 m.

*Menipea patagonica* Busk

St. 148. 9. i. 27. Off Cape Saunders, South Georgia, from 54° 03' S, 36° 39' W, to 54° 05' S, 36° 36' 30" W. 132-148 m.

*Notoplites antarcticus* (Waters)

*Caberea darwinii* Busk

*N. drygalskii* (Kluge)

*Cornucopina polymorpha* (Kluge)

St. 149. 10. i. 27. Mouth of East Cumberland Bay, South Georgia, from 1.15 miles N 76½° W to 2.62 miles S 11° W of Merton Rock. 200-234 m.

*Amastigia gausi* (Kluge)

*Camptoplites latus* var. *aspera* var.n.

St. 152. 17. i. 27. Off South Georgia, 53° 51' 30" S, 36° 18' 30" W. 245 m.

*Notoplites drygalskii* (Kluge)

St. 153. 17. i. 27. Off South Georgia, 54° 08' 30" S, 36° 27' 30" W. 106 m.

*Amastigia gausi* (Kluge)

*Caberea darwinii* Busk

St. 156. 20. i. 27. Off South Georgia, 53° 51' S, 36° 21' 30" W. 200-236 m.

*Camptoplites tricornis* (Waters)

*Camptoplites asymmetricus* sp.n.

*C. retiformis* (Kluge)

St. 158. 21. i. 27. Off South Georgia, 53° 48' 30" S, 35° 57' W. 401-411 m.

*Notoplites antarcticus* (Waters)

St. 159. 21. i. 27. Off South Georgia, 53° 52' 30" S, 36° 08' W. 160 m.

*Amastigia gausi* (Kluge)

*Beania erecta* var. *livingstonei* var.n.

- St. 160. 7. ii. 27. Near Shag Rocks, 53° 43' 40" S, 40° 57' W. 177 m.  
*Notoplites antarcticus* (Waters) *Beania erecta* Waters  
*N. crassiscutus* sp.n. *Camptoplites bicornis* var. *quadriavicularis* var.n.  
*Caberea darwinii* Busk *C. tricornis* (Waters)  
*Cornucopina ovalis* sp.n.
- St. 164. 18. ii. 27. East end of Normanna Strait, South Orkneys, near Cape Hansen, Coronation Island. 24-36 m.  
*Himantozoum antarcticum* (Calvet) *Camptoplites bicornis* var. *magna* (Kluge)
- St. 167. 20. ii. 27. Off Signy Island, South Orkneys, 60° 50' 30" S, 46° 15' W. 244-344 m.  
*Amastigia gaussi* (Kluge) *Camptoplites angustus* (Kluge)  
*Caberea darwinii* Busk
- St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island, 61° 25' 30" S, 53° 46' W. 342 m.  
*Beania erecta* var. *livingstonei* var.n.
- St. 172. 26. ii. 27. Off Deception Island, South Shetlands, 62° 59' S, 60° 28' W. 525 m.  
*Farciminellum antarcticum* sp.n.
- St. 175. 2. iii. 27. Bransfield Strait, South Shetlands, 63° 17' 20" S, 59° 48' 15" W. 200 m.  
*Notoplites drygalskii* (Kluge) *Beania erecta* var. *livingstonei* var.n.  
*Farciminellum antarcticum* sp.n. *Himantozoum antarcticum* (Calvet)  
*Cornucopina pectogemma* (Goldstein) *Camptoplites areolatus* (Kluge)  
*C. polymorpha* (Kluge)
- St. 177. 5. iii. 27. 27 miles SW of Deception Island, South Shetlands, 63° 17' 30" S, 61° 17' W. 1080 m.  
*Notoplites drygalskii* (Kluge) *Beania erecta* var. *livingstonei* var.n.
- St. 180. 11. iii. 27. 1.7 miles W of north point of Gand Island, Schollaert Channel, Palmer Archipelago. 160 m.  
*Amastigia gaussi* (Kluge) *Camptoplites bicornis* var. *elator* (Kluge)  
*Camptoplites bicornis* var. *magna* (Kluge)
- St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago, 64° 20' S, 63° 01' W. 160-335 m.  
*Notoplites antarcticus* (Waters) *Camptoplites retiformis* (Kluge)  
*N. drygalskii* (Kluge) *C. angustus* (Kluge), young colonies only  
*Cornucopina polymorpha* (Kluge)
- St. 187. 18. iii. 27. Neumayr Channel, Palmer Archipelago, 64° 48' 30" S, 63° 31' 30" W. 259-354 m.  
*Notoplites antarcticus* (Waters) *Camptoplites bicornis* var. *magna* (Kluge)  
*N. drygalskii* (Kluge) *C. retiformis* (Kluge)  
*Camptoplites bicornis* var. *compacta* (Kluge)
- St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago, 64° 56' S, 65° 35' W. 315 m.  
*Amastigia gaussi* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Cornucopina polymorpha* (Kluge) *Camptoplites bicornis* var. *elator* (Kluge)
- At same station in 93-126 m.  
*Amastigia gaussi* (Kluge) *Cornucopina polymorpha* (Kluge)  
*Notoplites vanhoeffeni* (Kluge) *Beania erecta* var. *livingstonei* var.n.  
*N. tenuis* (Kluge) *Camptoplites retiformis* (Kluge)  
*Caberea darwinii* Busk *C. latus* var. *striata* var.n.
- St. 195. 30. iii. 27. Admiralty Bay, King George Island, South Shetlands, 62° 07' S, 58° 28' 30" W. 391 m.  
*Caberea darwinii* Busk *Camptoplites retiformis* var. *tenuispina* var.n.

- St. 222. 23. iv. 27. St Martin's Cove, Hermite Island, Cape Horn. 30-35 m.  
*Menipea patagonica* Busk *Scruparia ambigua* (d'Orbigny)
- St. 299. 4. ix. 27. Tarafal, San Antonio, Cape Verde Islands. 7-11 m.  
*Bugula dentata* (Lamouroux)
- St. 363. 26. ii. 30. 2.5 miles S 80° E of south-east point of Zavodovski Island, South Sandwich Islands. 329-278 m.  
*Notoplites drygalskii* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Cornucopina pectogemma* (Goldstein) *Camptoplites retiformis* var. *tenuispina* var.n.
- St. 366. 6. iii. 30. 4 cables S of Cook Island, South Sandwich Islands. 77-152 m.  
*Notoplites drygalskii* (Kluge) *Farciminellum antarcticum* sp.n.  
*N. tenuis* (Kluge) *Cornucopina polymorpha* (Kluge)
- St. 371. 14. iii. 30. 1 mile E of Montagu Island, South Sandwich Islands. 99-161 m.  
*Notoplites drygalskii* (Kluge) *Beania erecta* (Waters)  
*N. tenuis* (Kluge) *Camptoplites retiformis* var. *tenuispina* var.n.  
*Caberea darwinii* Busk
- St. 388. 16. iv. 30. Off Cape Horn, 56° 19½' S, 67° 09¾' W. 121 m.  
*Amastigia benemunita* (Busk)
- St. 399. 18. v. 30. 1 mile SE of south-west point of Gough Island. 141-102 m.  
*Amastigia benemunita* (Busk) *Caberea darwinii* Busk  
*Scrupocellaria ornithorhyncus* Thomson *Aetea anguina* (Linnaeus)
- St. 456. 18. x. 30. 1 mile E of Bouvet Island. 40-45 m.  
*Himantozoum antarcticum* (Calvet)
- St. 474. 12. xi. 30. 1 mile W of Shag Rocks, South Georgia. 199 m.  
*Himantozoum antarcticum* (Calvet)
- St. 599. 17. i. 31. Adelaide Island, Bellingshausen Sea, 67° 08' S, 69° 06½' W. 203 m.  
*Amastigia gausi* (Kluge) *Camptoplites latus* var. *striata* var.n.
- St. 652. 14. iii. 31. Burdwood Bank, 54° 04' S, 61° 40' W. 171-169 m.  
*Tricellaria aculeata* (d'Orbigny)
- St. 724. 16. xi. 31. Fortescue Bay, Magellan Straits. 0-5 m.  
*Beania magellanica* (Busk)
- St. 929. 16. viii. 32. New Zealand, 34° 21' S, 172° 48' E to 34° 22' S, 172° 49.8' E. 58-55 m.  
*Menipea vectifera* Harmer *Caberea zelandica* (Gray)
- St. 933. 17. viii. 32. New Zealand, 34° 13' S, 172° 12' E. 260 m.  
*Menipea zelandica* sp.n.
- St. 934. 17. viii. 32. New Zealand, 34° 11' S, 172° 10' E. 92-98 m.  
*Tricellaria monotrypa* (Busk) *Caberea glabra* MacGillivray  
*Emma triangula* Hastings *C. angusta* sp.n.  
*Scrupocellaria ornithorhyncus* (Thomson) *Synnotum aegyptiacum* (Audouin)  
*Canda arachnoides* Lamouroux *Beania pulchella* Livingstone  
*Caberea helicina* sp.n. *Caulibugula tuberosa* Hastings  
*C. darwinii* Busk
- At same station in 100 m.  
*Amastigia harmeri* sp.n. *Caberea helicina* sp.n.  
*Emma triangula* Hastings *C. darwinii* Busk  
*Caberea boryi* (Audouin) *Cornucopina zelandica* sp.n.



- St. 935. 17. viii. 32. New Zealand, 34° 11' S, 172° 08' E. 84 m.  
*Amastigia harmeri* sp.n. *Canda arachnoides* Lamouroux  
*Menipea zelandica* sp.n. *Caberea angusta* sp.n.  
*M. vectifera* Harmer *Bugula cucullata* var. *cuspidata* var.n.  
*Emma triangula* Hastings
- St. 1187. 18. xi. 33. Inaccessible Island, Tristan da Cunha. 117-104 m.  
*Caberea rostrata* Busk *Aetea anguina* (Linnaeus)
- At same station in 135-134 m.  
*Caberea rostrata* Busk *Aetea anguina* (Linnaeus)
- St. 1230. 23. xii. 33. Magellan Strait. 27 m.  
*Tricellaria aculeata* (d'Orbigny)
- St. 1321. 16. iii. 34. West end of Magellan Strait. 66 m.  
*Scrupocellaria ornithorhyncus* (Thomson) *Beania inermis* var. *unicornis* var.n.  
*Caberea darwinii* Busk *B. magellanica* (Busk)
- St. 1562. 7. iv. 35. Marion Island. 90-97 m.  
*Amastigia kirkpatricki* Harmer *Caberea darwinii* Busk  
*Menipea flagellifera* Busk *Beania costata* (Busk)
- At same station in 97-104 m.  
*Amastigia kirkpatricki* Harmer *Notoplites elongatus* (Busk)  
*Menipea flagellifera* Busk *Caberea darwinii* Busk  
*M. kempfi* sp.n. *Beania magellanica* (Busk)
- St. 1563. 7. iv. 35. Marion Island. 101-106 m.  
*Amastigia kirkpatricki* Harmer *Caberea darwinii* Busk  
*Menipea flagellifera* Busk *Beania magellanica* Busk  
*Notoplites elongatus* (Busk)
- At same station in 113-99 m.  
*Amastigia kirkpatricki* Harmer *Notoplites elongatus* (Busk)  
*Menipea flagellifera* Busk *Caberea darwinii* Busk  
*M. kempfi* sp.n. *Beania magellanica* Busk
- St. 1564. 7. iv. 35. Prince Edward Island. 110-113 m.  
*Amastigia kirkpatricki* Harmer *Caberea darwinii* Busk  
*Menipea flagellifera* Busk *Beania magellanica* (Busk)
- St. 1648. 18. i. 36. Off Ice Barrier, Ross Sea, 78° 18' S, 174° 24' W. 550 m.  
*Beania erecta* Waters
- St. 1651. 22. i. 36. Ross Sea, 77° 04.3' S, 176° 26.1' W. 594 m.  
*Notoplites tenuis* (Kluge) *Camptoplites tricornis* (Waters)  
*Beania erecta* Waters
- St. 1652. 23. i. 36. Ross Sea, 75° 56.2' S, 178° 35.5' W. 567 m.  
*Notoplites drygalskii* (Kluge) *Camptoplites bicornis* var. *magna* (Kluge)  
*N. tenuis* (Kluge) *C. lewaldi* (Kluge)  
*Farciminellum antarcticum* sp.n. *C. tricornis* (Waters)  
*Cornucopina polymorpha* (Kluge) *C. angustus* (Kluge)  
*Beania erecta* Waters *C. retiformis* (Kluge)  
*Himantozoum antarcticum* (Calvet) *C. latus* (Kluge)  
*Camptoplites bicornis* var. *compacta* (Kluge)

- St. 1658. 26. i. 36. Ross Sea, 76° 09' 6" S, 168° 40' E. 520 m.  
*Notoplites drygalskii* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Cornucopina polymorpha* (Kluge)
- St. 1660. 27. i. 36. Ross Sea, 74° 46' 4" S, 178° 23' 4" E. 351 m.  
*Notoplites drygalskii* (Kluge) *Camptoplites bicornis* var. *compacta* (Kluge)  
*N. tenuis* (Kluge) *C. bicornis* var. *magna* (Kluge)  
*Caberea darwinii* Busk *C. lewaldi* (Kluge)  
*Farciminellum antarcticum* sp.n. *C. tricornis* (Waters)  
*Cornucopina polymorpha* (Kluge) *C. angustus* (Kluge)  
*Beania erecta* Waters *C. retiformis* (Kluge)  
*Himantozoum antarcticum* (Calvet) *C. rectilinearis* sp.n.  
*Bugula longissima* Busk
- St. 1686. 4. iii. 36. Queenscliffe Jetty, Port Phillip, Victoria, 38° 16' 1" S, 144° 40' 2" E. 0 m.  
*Scrupocellaria ornithorhyncus* Thomson *Scruparia ambigua* (d'Orbigny)  
*Aetea anguina* (Linnaeus)
- St. 1872. 12. xi. 36. Near Clarence and Elephant Islands, 63° 29' 6" S, 54° 03' 1" W. 247 m.  
*Notoplites drygalskii* (Kluge) *Himantozoum antarcticum* (Calvet)
- St. 1873. 13. xi. 36. Near Clarence and Elephant Islands, 61° 20' 8" S, 54° 04' 2" W. 210-180 m.  
*Himantozoum antarcticum* (Calvet)
- St. 1902. 28. xi. 36. Patagonian Shelf, 49° 48' S, 67° 39' 5" W. 50-80-50 m.  
*Amastigia benemunita* (Busk) *Aetea anguina* (Linnaeus)  
*Tricellaria aculeata* (d'Orbigny) *Scruparia ambigua* (d'Orbigny)
- St. 1909. 30. xi. 36. Burdwood Bank, 53° 53' 2" S, 60° 29' 9" W. 132 m.  
*Caberea darwinii* Busk *Beania magellanica* Busk
- St. 1948. 4. i. 37. North of Clarence and Elephant Islands, 60° 49' 4" S, 52° 40' W. 490-610 m.  
*Notoplites antarcticus* (Waters) *Camptoplites retiformis* (Kluge)  
*Caberea darwinii* Busk *Erymophora klugei* sp.n.  
*Camptoplites bicornis* var. *elator* (Kluge)
- St. 1952. 11. i. 37. Between Penguin Island and Lion's Rump, King George Island, South Shetlands. 367-383 m.  
*Farciminellum antarcticum* sp.n.
- St. 1961. 12. ii. 37. Near Elephant and Clarence Islands, South Orkneys, 60° 49' 5" S, 45° 27' 5" W. 340 m.  
*Himantozoum antarcticum* (Calvet)

## R.S.S. 'William Scoresby'

- St. WS 25. 17. xii. 26. Undine Harbour (North), South Georgia. 18-27 m.  
*Menipea patagonica* Busk *Caberea darwinii* Busk  
*Notoplites drygalskii* (Kluge)
- St. WS 27. 19. xii. 26. Off South Georgia, 53° 55' S, 38° 01' W. 106-109 m.  
*Notoplites drygalskii* (Kluge) *Beania erecta* var. *livingstonei* var.n.  
*Caberea darwinii* Busk *Himantozoum antarcticum* (Calvet)  
*Cornucopina pectogemma* (Goldstein) *Camptoplites tricornis* (Waters)  
*C. polymorpha* (Kluge)

- St. WS 33. 21. xii. 26. Off South Georgia, 54° 59' S, 35° 24' W. 130 m.  
*Notoplites drygalskii* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Caberea darwinii* Busk *Camptoplites giganteus* (Kluge)  
*Cornucopina pectogemma* (Goldstein) *C. tricornis* (Waters)  
*C. polymorpha* (Kluge) *C. retiformis* (Kluge)
- St. WS 42. 7. i. 27. Off South Georgia, 54° 41' 45" S, 36° 47' W. 198 m.  
*Amastigia gaussi* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Notoplites antarcticus* (Waters) *Camptoplites tricornis* (Waters)  
*Caberea darwinii* Busk *C. retiformis* (Kluge)  
*Farciminellum antarcticum* sp.n. *C. latus* var. *aspera* var.n.  
*Cornucopina pectogemma* (Goldstein)
- St. WS 56. 14. i. 27. Larsen Harbour, Drygalski Fjord, South Georgia. 2 m. Kelp roots.  
*Menipea patagonica* Busk
- St. WS 72. 5. iii. 27. Off Falkland Islands, 51° 07' S, 57° 34' W. 95 m.  
*Menipea patagonica* Busk *Tricellaria aculeata* (d'Orbigny)
- St. WS 73. 6. iii. 27. Off Falkland Islands, 51° 01' S, 58° 54' W. 121-130 m.  
*Notoplites elongatus* var. *calveti* var.n.
- St. WS 76. 11. iii. 27. Off Patagonian Shelf, 51° S, 62° 02' 30" W. 207-205 m.  
*Amastigia benemunita* (Busk)
- St. WS 79. 13. iii. 27. Patagonian Shelf, 51° 01' 30" S, 64° 59' 30" W. 132-131 m.  
*Amastigia benemunita* (Busk) *Notoplites elongatus* var. *calveti* var.n.  
*Menipea flagellifera* Busk *Tricellaria aculeata* (d'Orbigny)
- St. WS 80. 14. iii. 27. Patagonian Shelf, 50° 57' S, 63° 37' 30" W. 152-156 m.  
*Amastigia benemunita* (Busk)
- St. WS 81. 19. iii. 27. 8 miles N 11° W of North Island, West Falkland Island. 81-82 m.  
*Menipea flagellifera* Busk *Beania magellanica* (Busk)
- St. WS 82. 21. iii. 27. Burdwood Bank, 54° 06' S, 57° 46' W. 140-144 m.  
*Amastigia benemunita* (Busk) *Caberea darwinii* Busk  
*Menipea flagellifera* Busk
- St. WS 83. 24. iii. 27. 14 miles S 64° W of George Island, East Falkland Island. 137-129 m.  
*Notoplites elongatus* var. *calveti* var.n.
- St. WS 84. 24. iii. 27. 7½ miles S 9° W of Sea Lion Island, East Falkland Island. 75-74 m.  
*Amastigia nuda* Busk *Tricellaria aculeata* (d'Orbigny)  
*A. benemunita* (Busk) *Caberea darwinii* Busk  
*A. vibraculifera* sp.n. *Beania inermis* var. *unicornis* var.n.  
*Menipea patagonica* Busk *B. fragilis* (Ridley)  
*M. flagellifera* Busk *B. magellanica* (Busk)  
*Notoplites elongatus* var. *calveti* var.n. *Aetea anguina* (Linnaeus)
- St. WS 85. 25. iii. 27. 8 miles S 66° E of Lively Island, East Falkland Island. 79 m.  
*Amastigia nuda* Busk *Beania costata* var. *maxilla* (Jullien)  
*A. benemunita* (Busk) *B. inermis* (Busk)  
*A. vibraculifera* sp.n. *B. inermis* var. *unicornis* var.n.  
*Menipea flagellifera* Busk *B. fragilis* (Ridley)  
*Notoplites elongatus* var. *calveti* var.n. *B. magellanica* (Busk)  
*Tricellaria aculeata* (d'Orbigny) *Himantozoum obtusum* sp.n.  
*Caberea darwinii* Busk

- St. WS 86. 3. iv. 27. Burdwood Bank, 53° 53' 30" S, 60° 34' 30" W. 151-147 m.  
*Caberea darwinii* Busk
- St. WS 87. 3. iv. 27. Burdwood Bank, 54° 07' 30" S, 58° 16' W. 96-127 m.  
*Amastigia nuda* Busk *Menipea flagellifera* Busk  
*A. benemunita* (Busk) *Tricellaria aculeata* (d'Orbigny)  
*Menipea patagonica* Busk *Caberea darwinii* Busk
- St. WS 88. 6. iv. 27. Patagonian Shelf, 54° S, 64° 57' 30" W. 118 m.  
*Amastigia benemunita* (Busk) *Caberea darwinii* Busk  
*Menipea flagellifera* Busk *Beania inermis* (Busk)  
*Notoplites elongatus* var. *calveti* var.n. *B. magellanica* (Busk)  
*Tricellaria aculeata* (d'Orbigny)
- St. WS 93. 9. iv. 27. 7 miles S 80° W of Beaver Island, West Falkland Island. 133-130 m.  
*Beania magellanica* (Busk) *Camptoplites atlanticus* sp.n.  
*Himantozoum obtusum* sp.n.
- St. WS 95. 17. iv. 27. Patagonian Shelf, 48° 58' 15" S, 64° 45' W. 109-108 m.  
*Tricellaria aculeata* (d'Orbigny) *Scruparia ambigua* (d'Orbigny)  
*Caberea darwinii* Busk
- St. WS 128. 10. vi. 27. West side of Gough Island, inshore, 40° 19' S, 10° 04' W. 120-90 m.  
*Amastigia benemunita* (Busk)
- St. WS 177. 7. iii. 28. Off South Georgia, 54° 58' S, 35° W. 97-0 m.  
*Himantozoum antarcticum* (Calvet)
- St. WS 220. 3. vi. 28. Patagonian Shelf, 47° 56' S, 62° 38' W. 108-104 m.  
*Menipea flagellifera* Busk *Tricellaria aculeata* (d'Orbigny)
- St. WS 221. 4. vi. 28. Patagonian Shelf, 48° 23' S, 65° 10' W. 76-91 m.  
*Beania magellanica* (Busk)
- St. WS 222. 8. vi. 28. Patagonian Shelf, 48° 23' S, 65° W. 100-106 m.  
*Tricellaria aculeata* (d'Orbigny)
- St. WS 225. 9. vi. 28. Patagonian Shelf, 50° 20' S, 62° 30' W. 162-161 m.  
*Menipea flagellifera* Busk *Beania magellanica* (Busk)  
*Notoplites elongatus* var. *calveti* var.n. *Himantozoum obtusum* sp.n.  
*Caberea darwinii* Busk
- St. WS 228. 30. vi. 28. Off Patagonian Shelf, 50° 50' S, 56° 58' W. 229-236 m.  
*Menipea flagellifera* Busk *Himantozoum obtusum* sp.n.  
? *Cornucopina ovalis* var. *versa* var.n.
- St. WS 229. 1. vii. 28. Off Patagonian Shelf, 50° 35' S, 57° 20' W. 210-271 m.  
? *Cornucopina ovalis* var. *versa* var.n. *Himantozoum obtusum* sp.n.  
*Beania magellanica* (Busk)
- St. WS 231. 4. vii. 28. Off Falkland Islands, 50° 10' S, 58° 42' W. 167-159 m.  
*Amastigia benemunita* (Busk) *Beania magellanica* (Busk)  
*Menipea flagellifera* Busk *Himantozoum obtusum* sp.n.  
*Caberea darwinii* Busk *Camptoplites atlanticus* sp.n.
- St. WS 237. 7. vii. 28. Off Patagonian Shelf, 46° S, 60° 05' W. 150-256 m.  
*Amastigia benemunita* (Busk) *Notoplites elongatus* var. *calveti* var.n.  
*Menipea flagellifera* Busk *Beania magellanica* (Busk)
- St. WS 239. 15. vii. 28. Patagonian Shelf, 51° 10' S, 62° 10' W. 196-193 m.  
*Menipea flagellifera* Busk

- St. WS 243. 17. vii. 28. Patagonian Shelf, 51° 06' S, 64° 30' W. 144-141 m.  
*Amastigia benemunita* (Busk) *Caberea darwinii* Busk  
*Menipea flagellifera* Busk *Beania magellanica* (Busk)  
*Notoplites elongatus* var. *calveti* var.n.
- St. WS 244. 18. vii. 28. Off Patagonian Shelf, 52° S, 62° 40' W. 253-247 m.  
*Amastigia benemunita* (Busk) *Notoplites elongatus* var. *calveti* var.n.  
*Menipea flagellifera* Busk *Tricellaria aculeata* (d'Orbigny)
- St. WS 245. 18. vii. 28. Off Patagonian Shelf, 52° 36' S, 63° 40' W. 340-290 m.  
*Amastigia gaussi* (Kluge) *Notoplites elongatus* var. *calveti* var.n.  
*A. benemunita* (Busk) *Tricellaria aculeata* (d'Orbigny)  
*Menipea flagellifera* Busk
- St. WS 246. 19. vii. 28. Off Patagonian Shelf, 52° 25' S, 61° W. 267-208 m.  
*Amastigia benemunita* Busk ? *Cornucopina ovalis* var. *versa* var.n.  
*Menipea flagellifera* Busk *Himantozoum obtusum* sp.n.
- St. WS 247. 19. vii. 28. Off Falkland Islands, 52° 40' S, 60° 05' W. 172 m.  
*Notoplites elongatus* var. *calveti* var.n. *Caberea darwinii* Busk
- St. WS 249. 20. vii. 28. Off Falkland Islands, 52° 10' S, 57° 30' W. 166 m.  
*Himantozoum obtusum* sp.n.
- St. WS 755. 21. ix. 31. Off Falkland Islands, 51° 39' S, 57° 39' W. 77 m.  
*Amastigia benemunita* (Busk) *Beania magellanica* (Busk)  
*Caberea darwinii* Busk
- St. WS 765. 17. x. 31. Patagonian Shelf, 45° 07' S, 60° 28' 15" W. 113-118 m.  
*Amastigia benemunita* (Busk)
- St. WS 773. 31. x. 31. Off Patagonian Shelf, 47° 28' S, 60° 51' W. 291-296 m.  
*Camptoplites atlanticus* sp.n.
- St. WS 776. 3. xi. 31. Patagonian Shelf, 46° 18' 15" S, 65° 02' 15" W. 107-99 m.  
*Amastigia benemunita* (Busk) *Beania inermis* var. *unicornis* var.n.  
*Bicelliarella* sp.
- St. WS 781. 6. xi. 31. Off Falkland Islands, 50° 30' S, 58° 50' W. 148 m.  
*Amastigia benemunita* (Busk) *Notoplites elongatus* var. *calveti* var.n.
- St. WS 783. 5. xii. 31. Off Falkland Islands, 50° 08' S, 59° 50' W. 155 m. Haul I.  
*Himantozoum obtusum* sp.n.
- St. WS 784. 5. xii. 31. Patagonian Shelf, 49° 47' 45" S, 61° 05' W. 170-164 m.  
*Beania magellanica* (Busk)
- St. WS 794. 17. xii. 31. Patagonian Shelf, 46° 12' 37" S, 60° 59' 15" W. 123-126 m.  
*Notoplites elongatus* var. *calveti* var.n.
- St. WS 824. 19. i. 32. Off Falkland Islands, 50° 29' 15" S, 58° 27' 15" W. 146-137 m.  
*Menipea flagellifera* Busk *Camptoplites atlanticus* sp.n.  
*Notoplites elongatus* var. *calveti* var.n.
- St. WS 825. 28/29. i. 32. Off Falkland Islands, 50° 50' S, 57° 15' 15" W. 135-144 m.  
*Notoplites elongatus* var. *calveti* var.n. *Beania magellanica* (Busk)
- St. WS 836. 3. ii. 32. Patagonian Shelf, 53° 05' 30" S, 67° 38' W. 64 m.  
*Amastigia benemunita* (Busk)
- St. WS 838. 5. ii. 32. Patagonian Shelf, 53° 11' 45" S, 65° W. 148-159 m.  
*Amastigia benemunita* (Busk) *Tricellaria aculeata* (d'Orbigny)  
*Menipea flagellifera* Busk *Beania magellanica* (Busk)

- St. WS 840. 6. ii. 32. Off Patagonian Shelf, 53° 52' S, 61° 49' 15" W. 368-463 m.  
*Amastigia crassimarginata* (Busk) *Cornucopina ovalis* var. *versa* var.n.  
*Caberea darwinii* var. *guntheri* var.n. *Camptoplites asymmetricus* sp.n.
- St. WS 847. 9. ii. 32. Patagonian Shelf, 50° 15' 45" S, 67° 57' W (haul A), 50° 18' 45" S, 67° 44' W (haul B). 51-56 m.  
*Tricellaria aculeata* (d'Orbigny) *Aetea anguina* (Linnaeus)  
*Caberea darwinii* Busk *Scruparia ambigua* (d'Orbigny)
- St. WS 871. 1. iv. 32. Off Patagonian Shelf, 53° 16' S, 64° 12' W. 336-341 m.  
*Amastigia benemunita* (Busk) *Cornucopina ovalis* var. *versa* var.n.  
*Menipea flagellifera* Busk *Himantozoum obtusum* sp.n.  
*Tricellaria aculeata* (d'Orbigny) *Camptoplites bicornis* var. *quadriavicularis* var.n.  
*Caberea darwinii* var. *guntheri* var.n.

*Marine Biological Station*

- St. MS 14. 17. ii. 25. South Georgia, from 1.5 miles SE by S to 1.5 miles S  $\frac{1}{2}$ ° W of Sappho Point, East Cumberland Bay. 190-110 m.  
*Caberea darwinii* Busk
- St. MS 64. 24. ii. 26. South Georgia, 1.8 miles SE by S of King Edward Point Light, East Cumberland Bay. 15-7 m.  
*Caberea darwinii* Busk
- St. MS 65. 28. ii. 26. South Georgia, East Cumberland Bay, 1.6 miles SE of Hobart Rock to 1 cable N of Dartmouth Point. 39 m.  
*Menipea patagonica* Busk
- St. MS 68. 2. iii. 26. South Georgia, East Cumberland Bay, 1.7 miles S  $\frac{1}{2}$ ° E to 8  $\frac{1}{2}$  cables SE by E of Sappho Point. 220-247 m.  
*Camptoplites tricornis* (Waters)
- St. MS 71. 9. iii. 26. South Georgia, East Cumberland Bay, 9  $\frac{1}{4}$  cables E by S to 1.2 miles E by S of Sappho Point. 110-60 m.  
*Amastigia gaussi* (Kluge) *Camptoplites retiformis* (Kluge)
- St. MS 82. 6. ix. 26. Saldanha Bay, South Africa, off Salamander Point. 7-14 m.  
*Bugula calathus* Norman

*Unnumbered 'Discovery' Stations*

- Deception Island, South Shetlands. 1924. 46-55 m. dredged.  
*Camptoplites bicornis* var. *magna* (Kluge) *Camptoplites angustus* (Kluge)
- South Africa, outside Saldanha Bay, sea beach. 1926.  
*Menipea crispa* (Pallas) *Menipea triseriata* Busk

## BRITISH ANTARCTIC ('TERRA NOVA') EXPEDITION, 1910

See Harmer, S. F. & Lillie, D. G. (1914). *List of Collecting Stations. British Antarctic (Terra Nova) Exped. 1910. Zoology, II.*

- St. TN 36. 26 July 1910. South Trinidad Island. Between tide-marks.  
*Scrupocellaria ornithorhynchus* Thomson *Caberea glabra* MacGillivray
- St. TN 90. 25 July 1911. New Zealand, from Summit, Great King, Three Kings Islands, S 14° W, 8 miles. 183 m.  
*Cornucopina moluccensis* (Busk) *Cornucopina zelandica* sp.n.

St. TN 91. 26 July 1911. New Zealand, from Summit, Great King, Three Kings Islands, S 10° W, 25 miles. 549 m.

*Caberea helicina* sp.n. *Cornucopina moluccensis* (Busk)

St. TN 134. 31 August 1911. New Zealand, Spirits Bay, near North Cape. 20-37 m.

*Caberea rostrata* Busk *Bugula expansa* Hastings  
*Beania discodermiae* (Ortmann) *Scruparia ambigua* (d'Orbigny)  
*B. intermedia* (Hincks)

St. TN 144. 13 September 1911. New Zealand, from Cape Maria van Diemen, W by S, 7 miles (true bearing). 64-73 m.

*Tricellaria monotrypa* (Busk) *Caberea* sp. indet.  
*Emma triangula* Hastings *Cornucopina zelandica* sp.n.  
*Caberea zelandica* Gray *Bugula cucullata* var. *cuspidata* var.n.  
*C. glabra* MacGillivray *Dimetopia cornuta* Busk

St. TN 194. 22 February 1911. Off Oates Land, 69° 43' S, 163° 24' E. 329-366 m.

*Amastigia gausi* (Kluge) *Cornucopina polymorpha* (Kluge)  
*A. cabereoides* (Kluge) *C. lata* (Kluge)  
*A. antarctica* (Kluge) *Beania erecta* var. *livingstonei* var.n.  
*A. solida* (Kluge) *B. scotti* sp.n.  
*Notoplites antarcticus* (Waters) *Klugella echinata* (Kluge)  
*N. watersi* (Kluge) *Himantozoum antarcticum* (Calvet)  
*N. drygalskii* (Kluge) *Camptoplites tricornis* (Waters)  
*N. vanhoeffeni* (Kluge) *C. angustus* (Kluge)  
*N. tenuis* (Kluge) *C. retiformis* (Kluge)  
*N. tenuis* var. *uniserialis* var.n. *C. areolatus* (Kluge)  
*Caberea darwinii* Busk *Erymophora klugei* sp.n.  
*Farciminellum antarcticum* sp.n. *Brettia triplex* sp.n.  
*Cornucopina pectogemma* (Goldstein)

St. TN 220. 3 January 1912. Off Cape Adare, mouth of Robertson's Bay. 82-92 m.

*Notoplites drygalskii* (Kluge) *Cornucopina polymorpha* (Kluge)  
*Cornucopina pectogemma* (Goldstein) *Beania erecta* var. *livingstonei* var.n.

St. TN 294. 15 January 1913. Ross Sea, 74° 25' S, 179° 3' E. 289 m.

*Bugula longissima* Busk

St. TN 314. 23 January 1911. 5 miles N of Inaccessible Island, McMurdo Sound. 406-441 m.

*Amastigia antarctica* (Kluge) *Camptoplites bicornis* var. *magna* (Kluge)  
*Notoplites drygalskii* (Kluge) *C. tricornis* (Waters)  
*Cornucopina polymorpha* (Kluge) *C. angustus* (Kluge)  
*Camptoplites bicornis* var. *compacta* (Kluge) *C. rectilinearis* sp.n.

St. TN 316. 9 February 1911. Off Glacier Tongue, about 8 miles N of Hut Point, McMurdo Sound. 348-457 m.

*Amastigia antarctica* (Kluge) *Klugella echinata* (Kluge)  
*Notoplites drygalskii* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Caberea darwinii* Busk *Camptoplites tricornis* (Waters)  
*Cornucopina pectogemma* (Goldstein) *C. latus* (Kluge)  
*Beania erecta* var. *livingstonei* var.n.

St. TN 321. 13-17 August 1911. In contraction-crack between Inaccessible Island and Barne Glacier. 180-250 m.

*Caberea darwinii* Busk

St. TN 331. 14 January 1912. Off Cape Bird Peninsula, entrance to McMurdo Sound. 457 m.  
*Notoplites drygalskii* (Kluge) *Himantozoum antarcticum* (Calvet)  
*Beania erecta* var. *livingstonei* var.n.

St. TN 338. 23 January 1912. Ross Sea, 77° 13' S, 164° 18' E. 379 m.  
*Farciminellum antarcticum* sp.n.

St. TN 339. 24 January 1912. Ross Sea, 77° 5' S, 164° 17' E. 256 m.  
*Amastigia antarctica* (Kluge) *Camptoplites bicornis* var. *compacta* (Kluge)  
*Notoplites drygalskii* (Kluge) *C. bicornis* var. *magna* (Kluge)  
*N. vanhoeffeni* (Kluge) *C. tricornis* (Waters)  
*N. tenuis* (Kluge) *C. angustus* (Kluge)  
*Caberea darwini* Busk *C. retiformis* (Kluge)  
*Beania erecta* Waters *C. latus* (Kluge)  
*Himantozoum antarcticum* (Calvet) *C. rectilinearis* sp.n.

St. TN 340. 25 January 1912. Ross Sea, 76° 56' S, 164° 12' E. 293 m.  
*Notoplites drygalskii* (Kluge) *Camptoplites bicornis* var. *compacta* (Kluge)  
*N. tenuis* (Kluge) *C. giganteus* (Kluge)  
*Caberea darwini* Busk *C. tricornis* (Waters)  
*Farciminellum antarcticum* sp.n. *C. angustus* (Kluge)  
*Himantozoum antarcticum* (Calvet)

St. TN 348. 13 February 1912. Off Barne Glacier, McMurdo Sound. 366 m.  
*Notoplites vanhoeffeni* (Kluge) *Camptoplites retiformis* (Kluge)

St. TN 355. 20 January 1913. Antarctic, 77° 46' S, 166° 8' E. 549 m.  
 ? *Notoplites drygalskii* (Kluge) *Camptoplites retiformis* (Kluge)  
*Camptoplites tricornis* (Waters)

St. TN [unnumbered]. 23 August [year ?]. Doubtless Bay, Mongonui, New Zealand. 12 fm.  
*Emma triangula* Hastings

#### NATIONAL ANTARCTIC EXPEDITION, 1901-1904

##### S.S. 'Discovery'

For maps see: *Reports National Antarctic Expedition, 1901-4*, Natural History, 1, 1907. British Museum (Natural History).

The Polyzoa of the National Antarctic Expedition have passed through the hands of several workers, and it is therefore not surprising that some of the labels are incomplete or show discrepancies. As there is no station list from which these labels can be checked and amplified, I have consulted some manuscript notes made by Mr T. V. Hodgson, naturalist to the expedition, and compiled the chronological statement given below, which only includes stations that yielded Polyzoa.

##### A. *Outward voyage.*

9. i. 02. Cape Adare, 18 fm.  
 No Cellularine Polyzoa obtained.

13. i. 02. Off Coulman Island, 100 fm.  
 No Cellularine Polyzoa obtained.

15. i. 02. Cape Wadsworth, Coulman Island, 8-15 fm.  
 No Cellularine Polyzoa obtained.

27. i. 02. Off Barrier, 300 fm. (The map of the voyage shows that on this date the ship was off the Great Ice Barrier in 174° W.)  
*Notoplites drygalskii* (Kluge)



29. i. 02. East end of Barrier, 100 fm. (The map of the voyage shows that this was in  $162\frac{1}{2}^{\circ}$  W.)  
*Notoplites drygalskii* (Kluge) *Camptoplites lewalddi* (Kluge)  
*N. tenuis* (Kluge) *C. angustus* (Kluge), young colony only.  
*Beania erecta* Waters

B. *Winter Quarters, McMurdo Sound.*

(a) 8. ii. 02-21. iii. 02. Collections made within 20 fm. line with small dredge from whaler before ship became frozen in.

*Notoplites drygalskii* (Kluge) *Camptoplites lewalddi* (Kluge)  
*N. tenuis* (Kluge) *C. tricornis* (Waters)  
*Caberea darwinii* Busk

(b) Collections made through holes in the ice (either seal-holes enlarged by digging, or holes specially dug). The following yielded Polyzoa during the periods specified:

7. viii. 02. 178 fm. (No locality given, the depth corresponds to No. 5 hole in Hodgson's MS.)  
 No Cellularine Polyzoa obtained.

13. ix. 02-8. xi. 02. Cape Armitage. 100 fm.  
*Notoplites vanhoeffeni* (Kluge)

13. ix. 02-19. xi. 02. Hut Point. 12-20 fm.<sup>1</sup>  
 No Cellularine Polyzoa obtained.

13. x. 02-27. xii. 02. No. 4 hole. 500 yards SSE of Hut Point. 41 fm.  
 No Cellularine Polyzoa obtained.

14. i. 03-8. iv. 03. No. 6 hole. 3000 yards SSE of Hut Point. 124 or 130 fm.  
*Notoplites drygalskii* (Kluge) *Caberea darwinii* Busk  
*N. vanhoeffeni* (Kluge) *Camptoplites bicornis* var. *magna* (Kluge)  
*N. tenuis* var. *uniserialis* var.n.

22. iv. 03-2. vi. 03. No. 10 hole. 3500 yards SSE of Hut Point. 130 fm.  
*Amastigia antarctica* (Kluge) *Notoplites klugei* (Hasenbank)  
*Notoplites watersi* (Kluge) *Caberea darwinii* Busk  
*N. drygalskii* (Kluge) *Camptoplites bicornis* var. *magna* (Kluge)  
*N. tenuis* var. *uniserialis* var.n. *C. angustus* (Kluge)

29. iv. 03. No. 11 hole. 300 yards SSE of Hut Point. 28 fm.  
*Notoplites tenuis* (Kluge)

20. viii. 03-30. ix. 03. No. 12 hole. 25-30 fm.  
*Notoplites tenuis* (Kluge) *Caberea darwinii* Busk

2. i. 04. Hole (unnumbered). 180 fm.  
 No Cellularine Polyzoa obtained.

3. i. 04. Tent Island. 5-20 fm.  
 No Cellularine Polyzoa obtained.

C. *Homeward voyage.*

4. iii. 04.  $67^{\circ} 21' 46''$  S,  $155^{\circ} 21' 10''$  E. 256 and 354 fm.  
 (Depths taken from published map of voyage. Polyzoa labels give 250 and 254 fm. respectively.)  
 No Cellularine Polyzoa obtained.

19. iii. 04. Port Rosa, Auckland Island.  
*Tricellaria aculeata* Busk

26. iii. 04. Laurie Harbour.  
 No Cellularine Polyzoa obtained.

<sup>1</sup> Depth taken from letter from Hodgson to Kirkpatrick, 19. vii. 1905.

## SHACKLETON-ROWETT ('QUEST') EXPEDITION

South Georgia, May 1922.

*Amastigia gaussi* (Kluge)*Notoplites antarcticus* (Waters)*Caberea darwinii* Busk*Beania erecta* var. *livingstonei* var.n.*Himantozoum antarcticum* (Calvet)*Camptoplites giganteus* (Kluge)? *C. latus* var. *aspera* var.n.

## LIST OF SPECIES DISCUSSED

SCRUPOCELLARIIDAE				
<i>Amastigia</i> Busk, 1852	page	320	<i>Caberea</i> Lamouroux, 1816	page 365
1. <i>A. nuda</i> Busk		321	1. <i>C. boryi</i> (Audouin)	367
2. <i>A. harmeri</i> sp.n.		322	2. <i>C. helicina</i> sp.n.	368
3. <i>A. gaussi</i> (Kluge)		322	3. <i>C. zelandica</i> (Gray)	371
4. <i>A. benemunita</i> (Busk)		325	4. <i>C. darwinii</i> Busk	374
5. <i>A. kirkpatricki</i> Harmer		327	5. <i>C. darwinii</i> var. <i>occlusa</i> var.n.	385
6. <i>A. cabereoides</i> (Kluge)		327	6. <i>C. darwinii</i> var. <i>guntheri</i> var.n.	386
7. <i>A. vibraculifera</i> sp.n.		327	7. <i>C. angusta</i> sp.n.	389
8. <i>A. antarctica</i> (Kluge)		329	8. <i>C. rostrata</i> Busk	389
9. <i>A. pateriformis</i> (Busk)		330	9. <i>Caberea</i> sp.	390
10. <i>A. solida</i> (Kluge)		330		
11. <i>A. crassimarginata</i> (Busk)		331	EPISTOMIIDAE	
12. <i>A. abyssicola</i> (Kluge)		331	<i>Synnotum</i> Pieper, 1881	391
<i>Menipea</i> Lamouroux, 1812		331	1. <i>S. aegyptiacum</i> (Audouin)	391
1. <i>M. crispa</i> (Pallas)		332		
2. <i>M. patagonica</i> Busk		333	FARCIMINARIIDAE	
3. <i>M. flagellifera</i> Busk		335	<i>Farciminellum</i> Harmer, 1926	391
4. <i>M. kempi</i> sp.n.		336	1. <i>F. antarcticum</i> sp.n.	391
5. <i>M. triseriata</i> Busk		337	2. <i>F. hexagonum</i> (Busk)	393
6. <i>M. quadrata</i> (Busk)		337	3. <i>F. lineare</i> (Kluge)	393
7. <i>M. zelandica</i> sp.n.		337	<i>Levinsenella</i> Harmer, 1926	393
8. <i>M. vectifera</i> Harmer		339	1. <i>L. magna</i> (Busk)	393
<i>Notoplites</i> Harmer, 1923		339	<i>Kenella</i> Levinsen, 1909	394
1. <i>N. antarcticus</i> (Waters)		341	1. <i>K. biseriata</i> (Busk)	394
2. <i>N. watersi</i> (Kluge)		342		
3. <i>N. drygalskii</i> (Kluge)		342	BICELLARIELLIDAE	
4. <i>N. vanhoeffeni</i> (Kluge)		346	<i>Bicellariella</i> Levinsen, 1909	396
5. <i>N. elongatus</i> (Busk)		346	1. <i>Bicellariella</i> sp.	396
6. <i>N. elongatus</i> var. <i>calveti</i> var.n.		348	<i>Cornucopina</i> Levinsen, 1909	396
7. <i>N. tenuis</i> (Kluge)		350	1. <i>C. pectogemma</i> (Goldstein)	397
8. <i>N. tenuis</i> var. <i>uniserialis</i> var.n.		351	2. <i>C. conica</i> Harmer	398
9. <i>N. klugei</i> (Hasenbank)		352	3. <i>C. infundibulata</i> (Busk)	399
10. <i>N. crassiscutus</i> sp.n.		353	4. <i>C. polymorpha</i> (Kluge)	399
11. <i>N. perditus</i> (Kluge)		355	5. <i>C. lata</i> (Kluge)	402
<i>Tricellaria</i> Fleming, 1828		356	6. <i>C. ovalis</i> sp.n.	402
1. <i>T. monotrypa</i> (Busk)		356	7. <i>C. ovalis</i> var. <i>versa</i> var.n.	404
2. <i>T. aculeata</i> (d'Orbigny)		356	8. <i>C. zelandica</i> sp.n.	405
3. <i>Tricellaria</i> sp.		359	9. <i>C. moluccensis</i> (Busk)	406
<i>Emma</i> Gray, 1843		360	10. <i>C. angulata</i> (Kluge)	406
1. <i>E. triangula</i> Hastings		360	11. <i>C. rotundata</i> (Kluge)	406
<i>Scrupocellaria</i> Van Beneden, 1845		360	<i>Beania</i> Johnston, 1840	408
1. <i>S. ornithorhynchus</i> Thomson		360	1. <i>B. costata</i> (Busk)	408
2. <i>S. frondis</i> Kirkpatrick		361	2. <i>B. costata</i> var. <i>maxilla</i> (Jullien)	409
<i>Canda</i> Lamouroux, 1816		364	3. <i>B. discodermiae</i> (Ortmann)	410
1. <i>C. arachnoides</i> Lamouroux		364		

4. <i>Beania inermis</i> (Busk)	page 411	3. <i>Camptoplites bicornis</i> var. <i>magna</i>	
5. <i>B. inermis</i> var. <i>unicornis</i> var.n.	412	(Kluge)	page 445
6. <i>B. fragilis</i> (Ridley)	413	4. <i>C. bicornis</i> var. <i>elator</i> (Kluge)	447
7. <i>B. pulchella</i> Livingstone	414	5. <i>C. bicornis</i> var. <i>quadriavicularis</i> var.n.	447
8. <i>B. magellanica</i> (Busk)	414	6. <i>C. lewaldi</i> (Kluge)	449
9. <i>B. challengerii</i> sp.n.	415	7. <i>C. giganteus</i> (Kluge)	451
10. <i>B. erecta</i> Waters	416	8. <i>C. tricornis</i> (Waters)	451
11. <i>B. erecta</i> var. <i>livingstonei</i> var.n.	417	9. <i>C. abyssicolus</i> (Kluge)	452
12. <i>B. scotti</i> sp.n.	418	10. <i>C. angustus</i> (Kluge)	452
13. <i>B. intermedia</i> (Hincks)	419	11. <i>C. retiformis</i> (Kluge)	453
<i>Klugella</i> gen.n.	420	12. <i>C. retiformis</i> var. <i>tenuispina</i> var.n.	455
1. <i>K. echinata</i> (Kluge)	421	13. <i>C. latus</i> (Kluge)	458
2. <i>K. buski</i> nom.n. for <i>Flustra</i>		14. <i>C. latus</i> var. <i>striata</i> var.n.	458
<i>crassa</i> Busk	422	15. <i>C. latus</i> var. <i>aspera</i> var.n.	458
<i>Himantozoum</i> Harmer, 1923	422	16. <i>C. atlanticus</i> sp.n.	460
1. <i>H. antarcticum</i> (Calvet)	422	17. <i>C. rectilinearis</i> sp.n.	462
2. <i>H. obtusum</i> sp.n.	424	18. <i>C. reticulatus</i> (Busk)	462
3. <i>H. sinuosum</i> (Busk)	425	19. <i>C. lunatus</i> Harmer	464
4. <i>H. sinuosum</i> var. <i>variabilis</i> (Kluge)	426	20. <i>C. areolatus</i> (Kluge)	465
<i>Bugula</i> Oken 1815	426	21. <i>C. asymmetricus</i> sp.n.	466
1. <i>B. calathus</i> Norman	426	<i>Erymophora</i> gen.n.	469
2. <i>B. cucullata</i> var. <i>cuspidata</i> var.n.	427	1. <i>E. gracilis</i> (Nichols)	470
3. <i>B. dentata</i> (Lamouroux)	429	2. <i>E. klugei</i> sp.n.	470
4. <i>B. hyadesi</i> Jullien	430	AETEIDAE	
5. <i>B. neritina</i> (Linnaeus)	430	<i>Aetea</i> Lamouroux 1812	471
6. <i>B. longissima</i> Busk	431	1. <i>A. anguina</i> (Linnaeus)	471
<i>Caulibugula</i> Verrill 1900	433	2. <i>A. curta</i> Jullien	473
1. <i>C. tuberosa</i> Hastings	433	SCRUPARIIDAE	
<i>Kinetoskias</i> Daniellsen, 1868	433	<i>Scruparia</i> Oken 1815	475
1. <i>K. pocillum</i> Busk	433	1. <i>S. ambigua</i> (d'Orbigny)	475
<i>Camptoplites</i> Harmer 1923	433	<i>Brettia</i> Dyster 1858	476
1. <i>C. bicornis</i> (Busk)	443	1. <i>B. inornata</i> (Goldstein)	476
2. <i>C. bicornis</i> var. <i>compacta</i> (Kluge)	445	2. <i>B. triplex</i> sp.n.	476

SYSTEMATIC DESCRIPTIONS

In the statements of Station Distribution, showing the stations from which each species was obtained by the Discovery Investigations, the stations have been grouped according to the areas recognized in Table 3, p. 479. Particulars of the stations with lists of the species obtained from each are given on p. 305.

The geographical distribution of the species has been stated in general terms. The term "Patagonian Shelf" covers the region east of the Patagonian coast down to 200 m., and includes the Falkland Islands and the Burdwood Bank (see map, Fig. 6o). Stations below 200 m. in this region are recorded as "off Patagonian Shelf". The channels around Tierra del Fuego, from the Straits of Magellan to Cape Horn, appear as the "Magellanic Region". "Ross Sea" includes McMurdo Sound.

Unless otherwise stated the figures have been drawn by means of a camera lucida from specimens mounted in canada balsam and seen by transmitted light. In many of the figures drawn in this way the opesia has been arbitrarily stippled for clarity.

Definitions of the families represented in this report are given by Harmer (1926).

## KEY TO THE GENERA OF SCRUPOCELLARIIDAE DISCUSSED HERE

Definitions of the genera of this family are given by Harmer (1923 and 1926), and should be consulted as the genera are recognized on the sum of many characters, few of which are constant throughout the genus, and the following key is therefore unsatisfactory.

1. Basal heterozooecia vibracula covering greater part of basal surface ... .. Caberea  
 Basal heterozooecia, when present, avicularia, or vibracula covering only a small part of the basal surface ... .. 2
2. Inner series of zooecia (when colony pluriserial) tend to be excluded from basal surface.  
 True joints with chitinous tubes<sup>1</sup> absent except in *A. kirkpatricki* (which is biserial) ... .. Amastigia  
 Inner series of pluriserial colonies reach basal surface normally. True joints present except in some pluriserial *Menipea* spp. ... .. 3
3. Colony biserial. Basal heterozooecia vibracula, usually present ... .. 4  
 Colony biserial or pluriserial. Basal heterozooecia avicularia when present ... .. 5
4. Branches connected by cross-rootlets which join two vibracula. Joint crosses opesia of inner zoecium ... .. Canda  
 Cross-rootlets rarely present and only attached to a vibraculum at one end. Joint crosses opesia of outer zoecium ... .. Scrupocellaria
5. Zooecia grouped in short internodes frequently of only two or three zooecia. No basal heterozooecia. Bifurcation of types 9-14 (see Harmer, 1923) ... .. 6  
 Zooecia form longer internodes. Basal heterozooecia avicularia, when present. Bifurcation of types 15, 17 or 18 ... .. 7
6. Cryptocyst not extensive. Bifurcation of types 9-12 ... .. Tricellaria  
 Cryptocyst extensive.<sup>2</sup> Bifurcation of types 13 or 14 ... .. Emma
7. Bifurcation of type 15. Scutum present or absent. Basal avicularia usually axillary when present... .. Notoplites  
 Bifurcation of types 17 or 18. Scutum absent. Basal avicularia absent except in *M. vectifera* ... .. Menipea

## Amastigia Busk 1852

## Key to the recent species

In this key I have omitted *Amastigia abyssicola* (Kluge), a deep-water Antarctic species which I have not seen (see p. 331). Some fossil species are known (see p. 496).

1. Heterozooecia present ... .. 2  
 Heterozooecia absent ... .. Amastigia sp.<sup>3</sup>
2. Basal heterozooecia present ... .. 3  
 Basal heterozooecia absent ... .. *A. funiculata*<sup>4</sup>
3. Mandible of basal heterozooecium more or less setiform ... .. 4  
 Mandible of basal heterozooecium not setiform ... .. 12

<sup>1</sup> See Harmer (1923, p. 32).

<sup>2</sup> Except in *E. cyathus*, see p. 358.

<sup>3</sup> Described under *A. kirkpatricki*, p. 327.

<sup>4</sup> For the species of *Amastigia* not discussed in this report see Harmer (1923).

4. Seta truly vibracular (i.e. asymmetrical at base with movement in more than two directions) ... .. 5  
 Seta an elongate avicularian mandible (i.e. symmetrical at base with opening and shutting movement only) ... .. 9
5. Gigantic frontal avicularia present, branches (in part at least) with more than two series of zooecia ... .. 6  
 Gigantic avicularia absent, branches biserial, except for median zooecium at bifurcation ... .. 11. *A. crassimarginata*
6. Gigantic avicularia on marginal zooecia only, numerous ... .. *A. rudis*<sup>1</sup>  
 Gigantic avicularia chiefly on inner zooecia, few ... .. 7
7. True joints regularly present at bifurcation, crossing opesia of outer zooecium, scutum absent ... .. 5. *A. kirkpatricki*  
 Joints, when present, of secondary "fracture" type, scutum present ... .. 8
8. Branches 3- to 6-serial (except at base of colony), zooecia relatively short, scutum pear-shaped, spines on marginal zooecia 4:1 ... .. 7. *A. vibraculifera*  
 Branches 2- to 4-serial, zooecia relatively long, scutum with more marked distal and proximal lobes, spines on marginal zooecia 2 (rarely 3):1 ... .. 6. *A. cabereoides*
9. Scutum absent, frontal avicularia rather conspicuous... .. 10  
 Scutum present, frontal avicularia not conspicuous ... .. 11
10. Frontal avicularia all unpaired ... .. 9. *A. pateriformis*  
 Frontal avicularia paired on inner zooecia ... .. 8. *A. antarctica*
11. Scutum with indented margin, branches 2-4 serial, cryptocyst wide ... .. 10. *A. solida*  
 Scutum with smooth margin and prominent truncate distal lobe, branches with 3-7, or more, series of zooecia, cryptocyst moderate ... .. 4. *A. benemunita*
12. Spines small and inconspicuous, except a few extremely large ones constricted at base, zooecia and ovicells long ... .. 3. *A. gaussi*  
 Spines usually fairly stout and conspicuous but none gigantic, zooecia and ovicells not particularly long ... .. 13
13. Blade of scutum round, inner zooecia taking very small part in formation of basal wall and completely excluded in some branches, frontal surface correspondingly convex ... .. 2. *A. harmeri*  
 Scutum with long proximal lobe, inner rows contributing more to basal surface and never completely excluded, frontal surface flatter than in *A. harmeri* ... .. 1. *A. nuda*

1. *Amastigia nuda* Busk. Figs. 1 B, 2 D, E.

*Amastigia nuda* Busk, 1852b, p. 40, pl. xxxvi, figs. 4, 5; Calvet, 1904, p. 7; part Harmer, 1923, p. 330, pl. xvii, fig. 24.

*Menipea benemunita* Busk (part), 1884, p. 19 (specimens from Chall. St. 149, Kerguelen).

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 84, WS 85, WS 87.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region (Busk; Calvet); Patagonian Shelf (Discovery); Kerguelen (Harmer).

Reasons are given (p. 322) for regarding the nearly related Australian form as a species (*Amastigia harmeri*) distinct from *A. nuda*.

One Challenger Kerguelen colony (87.12.9.68) is a typical specimen of *A. nuda*, and additional typical material from the same station has recently been recognized (35.3.12.1). Another Challenger colony from Kerguelen (87.12.9.75) approaches

<sup>1</sup> For the species of *Amastigia* not discussed in this report see Harmer (1923).

*A. gaussi* (Kluge) (see below) in the length of the zooecia, but agrees with *A. nuda* in the size and number of its spines and the absence of giant spines. In this specimen one of the distal spines commonly curves over the aperture, following the outline of the distal border of the scutum. Hasenbank's supposed specimen of *A. nuda* (1932, p. 362) from Bouvet Island clearly belonged to *A. gaussi*. Calvet unfortunately gave no description, but his specimen came from the region of the type-locality of *A. nuda* and presumably belonged to that species.

A median, longitudinal, basal heterozooecium is sometimes present before a bifurcation both in the type and in the present material. It is similar in shape to the lateral basal heterozooecia (Figs. 2 D, E; see p. 325).

## 2. *Amastigia harmeri* sp.n.

*Amastigia nuda* MacGillivray, 1887b, p. 200 [not *A. nuda* Busk, 1852]; part Harmer, 1923, p. 330, pl. xvii, figs. 21, 25, pl. xix, figs. 50, 51; Livingstone, 1929, p. 54.

STATION DISTRIBUTION. *New Zealand*: Sts. 934, 935.

GEOGRAPHICAL DISTRIBUTION. Victoria (MacGillivray; Harmer); New Zealand (Livingstone; Discovery).

HOLOTYPE. Port Phillip Heads. Bracebridge Wilson Collection, 97.5.1.246. Figured by Harmer.

With the exception of Fig. 24, Harmer's drawings of *Amastigia nuda* all represent the Victorian form, which, now that a little more material of the true South American *A. nuda* is available, is found to show certain constant differences and is here regarded as a distinct species, *A. harmeri*. Harmer's figs. 49 and 50 show the characteristic scutum which is rounded, with the proximal lobe not much larger than the distal. The lumen is narrow and runs across the scutum in a line with the stalk, widening more or less at the edge.

In the type and other South American specimens of *A. nuda* the proximal lobe of the scutum is longer and the lumen extends into it (Fig. 1 B). The cryptocyst of *A. harmeri* is wider than that of *A. nuda* and is more granular. Another difference which appears to be constant is the greater size, and particularly width, of the uncalcified frontal area in the ectooecium in *A. harmeri*. The difference in the basal surface of the branch is less sharply defined, but on the whole the inner rows contribute less to its formation in *A. harmeri*, and there are nearly always some branches in which the basal surface is formed entirely by the marginal zooecia. The greater part played by the marginal zooecia in forming the basal surface results in their outer edges being turned more basally so that the marginal avicularia, when present, are also directed more or less basally instead of laterally. The differences are slight, but, as far as the evidence goes, definite.

It may reasonably be assumed that Livingstone's specimens from New Zealand belonged to *A. harmeri*.

## 3. *Amastigia gaussi* (Kluge). Figs. 1 A, C.

*Scrupocellaria gaussi* Kluge, 1914, p. 609, pl. xxvii, figs. 9, 10 [not figs. 3 and 4].

*Amastigia gaussi* Harmer, 1923, p. 338.

*Amastigia nuda* Hasenbank, 1932, p. 362.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, St. WS 245. *Antarctic*: Weddell Quadrant, Sts. 27, 39, 42, 140, 149, 153, 159, 167, 180, 190, 599, WS 42, MS 71.

GEOGRAPHICAL DISTRIBUTION. Off Patagonian Shelf, below 300 m. (Discovery); South Georgia (Shackleton-Rowett Expedition; Discovery); Bouvet Island (Hasenbank); South Orkney Islands; Palmer Archipelago; Adelaide Island (Discovery); Wilhelm II Land (Kluge); Oates Land (Terra Nova).

Comparison of Kluge's description and figures shows that figs. 3 and 4, on pl. xxvii, represent *Amastigia cabereoides* and figs. 9 and 10 *A. gaussi*, not the reverse as indicated. Harmer (1923, pp. 335, 338) apparently overlooked this, consequently describing the

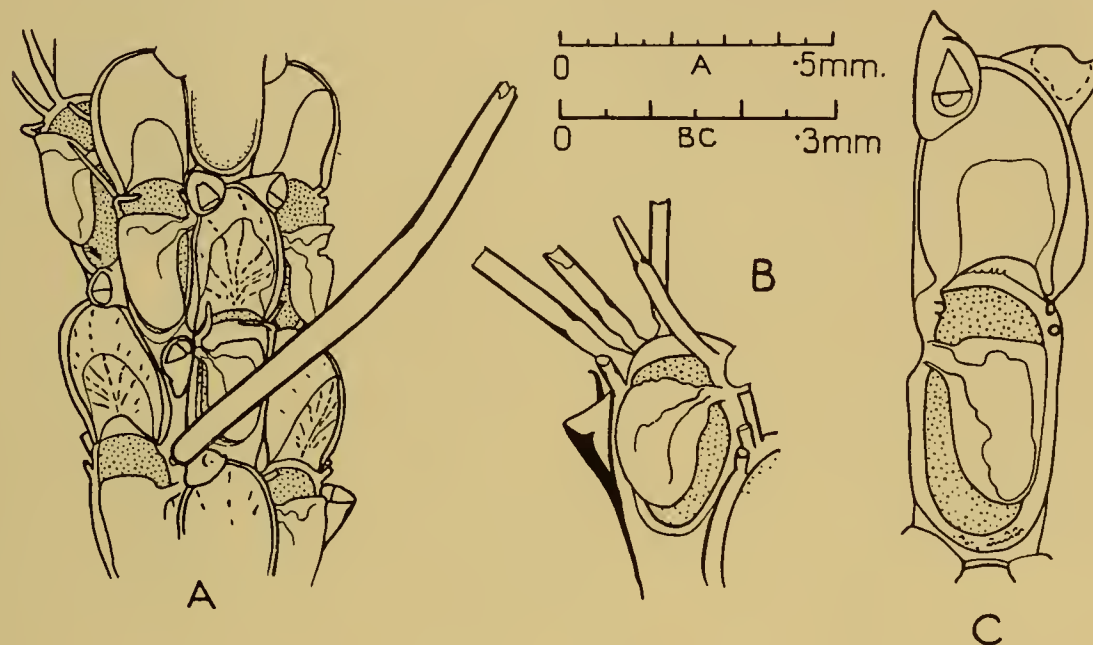


Fig. 1. A. *Amastigia gaussi* (Kluge). 23.12.1.28. South Georgia. To show giant spine and small size of other spines. B. *A. nuda* Busk. St. WS 84, Falkland Islands. One zoecium from a colony found attached to the limb of a Pycnogon (*Pallenopsis glabra*). C. *A. gaussi* (Kluge). St. 140, South Georgia. A fertile zoecium from one of the inner rows in slightly oblique view. One of the avicularia distal to the ovicell is broken.

scutum and basal heterozoecium of *A. gaussi* under *A. cabereoides*, and mentioning *A. gaussi*, instead of *A. cabereoides*, as being related to *A. kirkpatricki*.

*A. gaussi* is closely related to *A. nuda* (cf. Fig. 1 A, C with B) from which it is distinguished by its long zoecia, with long gymnocyst, long opesia, and correspondingly long proximal lobe to the scutum, and by its long straight-sided ovicells. Spines are on the whole less numerous. For example, 2 : 1 as noted by Kluge is common on marginal zoecia, though 3 : 1 is not infrequent, but 4 : 2 (a common but by no means constant number in *A. nuda*) has not been found. Most of the spines are small and very inconspicuous, but in every specimen I have examined (with the exception of a few small fragments) a few of the inner spines are of gigantic size, much larger than any found in *A. nuda*. These gigantic spines have a slender base and widen suddenly. The spines of

*A. nuda* do not have this very marked basal constriction. Most of them are moderately long and stout, so that, in spite of the absence of the gigantic ones, the species usually looks more spiny than *A. gaussi*, its appearance being well shown in Busk's figure. Even when the gigantic spines of *A. gaussi* are broken off the shape of the remaining basal portion is characteristic. A difference in the size of the basal avicularia of the two species is noticeable, but, as many instances of variation in size within a species are

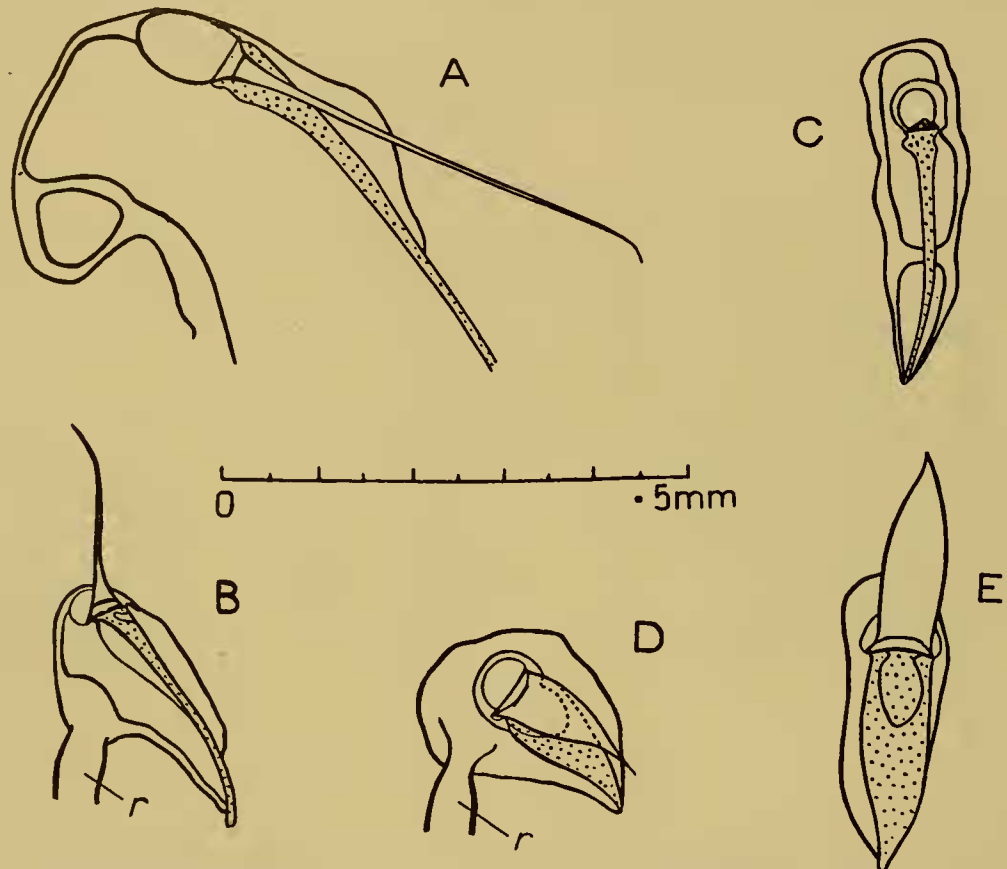


Fig. 2. A-C. *Amastigia benemunita* (Busk). A. From St. WS 85, Falkland Islands. Large lateral basal avicularium with part of proximal limb omitted. B. From St. 399, Gough Island. Smallest kind of lateral basal avicularium (cf. *A. nuda*, fig. D). C. From St. 399, Gough Island. Median basal avicularium at bifurcation. Mandible broken and foreshortened. D, E. *A. nuda* Busk. St. WS 84, Falkland Islands. D. Lateral basal avicularium. E. Median basal avicularium at bifurcation.

Grooves into which mandibles fit are stippled. *r.* rootlet.

known, this difference is probably not of systematic value. The distal wall of the fertile zooecium of *A. gaussi* commonly bears a few teeth directed towards the ovicell (Fig. 1 C), but they may be absent, or only represented by a single tooth. Such teeth have not been seen in *A. nuda*. From his description of the scutum, the spines and the ovicell it is clear that Hasenbank's material from Bouvet Island identified as *A. nuda*, belonged to *A. gaussi*.

There is some variation in the size of the frontal avicularia of *A. gaussi*. This is most noticeable in the specimen from St. 167 which has some rather large ones. A fragment from St. 599 has no scuta.



The relationship of *A. gaussi* to *A. nuda* and *A. harmeri* seems to be comparable to the relationship of the Antarctic type of *Caberea darwinii* to the *minima* type and *C. glabra* (see p. 383). It may seem inconsistent to have given them different taxonomic status. My reason is that in *C. darwinii* such characters as the number of spines and the size and length of zooecia intergrade so that no satisfactory line of demarcation is to be found. In *Amastigia gaussi* these relative differences are coupled with a positive character in the presence or absence of the giant spines with constricted base, and it can thus be distinguished with precision from *A. nuda*.

4. *Amastigia benemunita* (Busk). Figs. 2 A-C, 3 A, B.

*Menipea benemunita* Busk, 1884, p. 19, pl. iv, figs. 4, 4a.

*Amastigia benemunita* Harmer, 1923, pp. 331, 333, 334 (references).

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 388, 399, 1902, WS 76, WS 79, WS 80, WS 82, WS 84, WS 85, WS 87, WS 88, WS 128, WS 231, WS 237, WS 243, WS 244, WS 245, WS 246, WS 755, WS 765, WS 776, WS 781, WS 836, WS 838, WS 871.

GEOGRAPHICAL DISTRIBUTION. Gough Island (Discovery); Magellanic Region (Jullien; Discovery); Patagonian Shelf (Busk; Hamburg Museum, B. 809, B. 812; U.S. National Museum; Discovery); off Patagonian Shelf down to 339 m. (Discovery; Chile (Busk)).

Harmer noted that two apparently distinct types of basal heterozooecia may be found in *Amastigia benemunita*, resembling those of *A. rudis* and *A. nuda* respectively. The Discovery material has both kinds, but the variation in form and resemblance to avicularia of other species only concern the shape of the avicularian chamber, while the mandible and the beak, or groove, in which it lies are relatively constant, except in size, and differ in shape from those of both *A. rudis* and *A. nuda*.

The avicularian chamber may be more or less L-shaped, with a smaller transverse limb, ending in the rootlet-chamber, and a larger longitudinal limb (Figs. 2 A, 3 A) as in *A. rudis*; or it may be almost oval (Fig. 2 B) as in *A. nuda*; and intermediate states, such as that figured by Levinsen, are found. The proximal limb when present varies in shape and, in narrow branches, where heterozooecia of opposite sides meet, may be considerably distorted (Fig. 3 A). The mandible is apt to be small, or even absent, in these irregularly shaped avicularia. In *A. rudis* (Harmer, 1923, p. 332) the seta is long and slender, and its articulating base has the asymmetrical structure of the true vibraculum as understood by Waters (1913, p. 481). The groove in which it lies is somewhat twisted and its outer border forms a lobe over the articulation. The mandible of *A. nuda* (Fig. 2 D and Harmer, 1923, pl. xvii, fig. 25) is relatively broad with convex sides, and the calcareous parts into which it fits are completely symmetrical and lie in a plane parallel to the surface of the branch. In *A. benemunita* the mandible is setiform with concave lateral borders (Fig. 2 A, B) and lies in a plane slightly oblique to the surface of the branch; but the seta, which is shorter than that of *A. rudis*, is a true mandible with a symmetrical base. The groove is slightly asymmetrical, but there is no lobe. Harmer stated that the single basal heterozooecium in the Challenger specimen (87.12.9.70) of *A. benemunita* resembled those of *A. nuda*, but re-examination in the

light of what has been learnt from the Discovery specimens, shows that it is distinguished from those of *A. nuda* by the features just enumerated.

These three species can thus be distinguished by their basal heterozoecia as distinctly as by other characters, and they form an interesting graded series in which *A. nuda* has a true avicularium, *A. benemunita* an avicularium showing some of the characteristics of a vibraculum, and *A. rudis* a true vibraculum.

A median basal heterozoecium is commonly present at the bifurcation in these specimens (Fig. 2 C) and a few are to be seen in the type specimen. Like the lateral

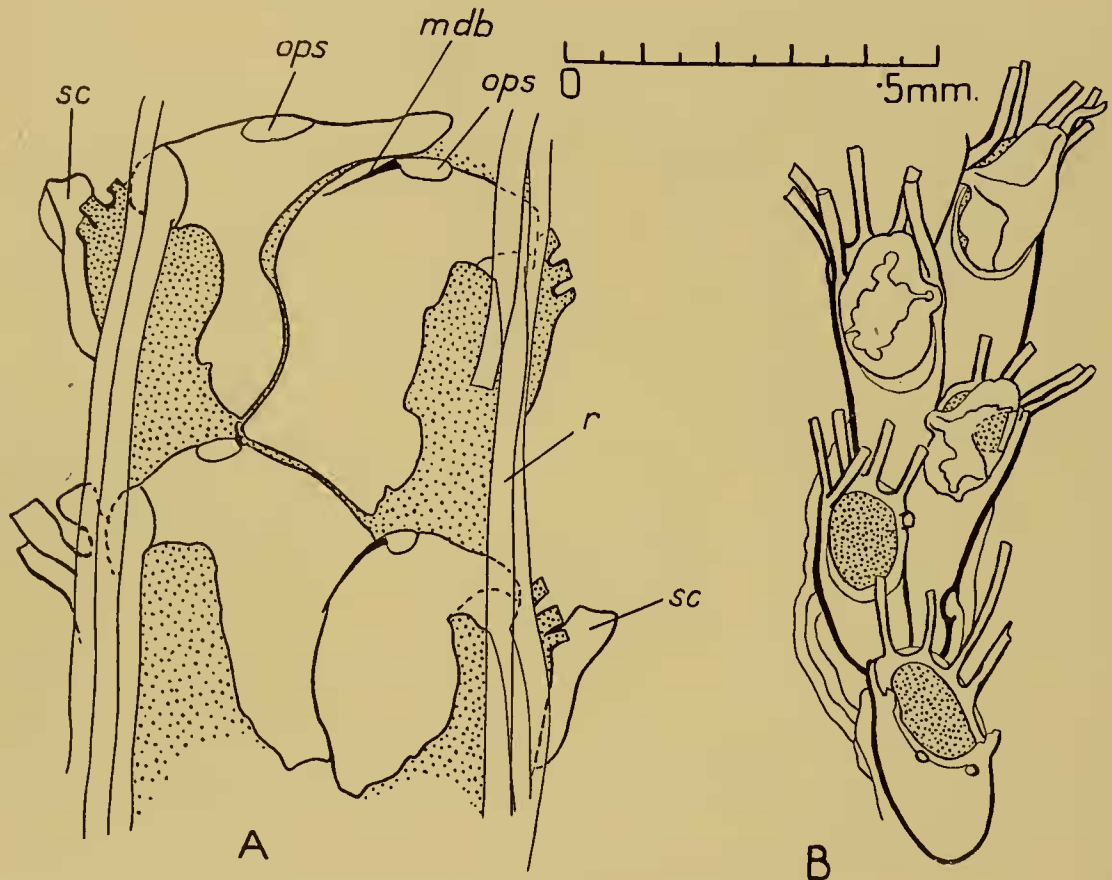


Fig. 3. A. *Amastigia benemunita* (Busk). St. WS 82, Falkland Islands. Basal view of a narrow branch with large basal avicularium. The underlying zoecia are stippled, and the outlines of their basal walls omitted for clarity. Three mandibles are shown, one being open and very short. The fourth heterozoecium has an opesia, but no mandible. B. *A. benemunita* (Busk). Challenger St. 315. Young colony with ancestrula. 34.11.12.47.

*mdb*, mandible, *ops*, opesia of heterozoecium, *r*, rootlets, *sc*, scutum.

basal heterozoecia, which are larger, it has a chamber of variable shape. The mandible is articulated some distance from the distal end of the chamber and is directed straight backwards (i.e. proximally along the branch). The distal prolongation of the chamber is often visible in frontal view as a small triangular cell in the angle of the bifurcation. Marginal avicularia, when present, are most commonly on the zoecia bordering the axil.

A small colony found among unnamed material from Challenger St. 315 (34. 11. 12. 47) has an ancestrula (Fig. 3 B).

5. *Amastigia kirkpatricki* Harmer.

*Caberea kirkpatricki* Levinsen, MS.

*Amastigia kirkpatricki* Harmer, 1923, p. 335, pl. xvii, fig. 20, pl. xix, figs. 46, 48.

*Menipea marionensis* part Busk, 1884, p. 21, pl. xiv, fig. 9.

STATION DISTRIBUTION. *Sub-Antarctic*: South Indian Ocean, Sts. 1562, 1563, 1564.

GEOGRAPHICAL DISTRIBUTION. Marion Island (Harmer; Discovery); Prince Edward Island (1937. 1. 2. 1; Discovery).

The Discovery specimens agree very closely with the type-material and with Harmer's description.

A few small pieces of *Amastigia* sp. found among unnamed Challenger material from Marion Island (34. 2. 16. 45) agree with *A. kirkpatricki* in the shape of the zooecia and ovicells and in the absence of scuta. The zooecia are a little larger, the internodes longer with a correspondingly longer series of median zooecia, and spines and heterozooecia are completely absent. The position of this form cannot be settled from such scanty material.

6. *Amastigia cabereoides* (Kluge). Fig. 4 D.

*Scrupocellaria cabereoides* Kluge, 1914, p. 612, pl. xxvii, figs. 3, 4 [not figs. 9, 10, see p. 323 above].

*Amastigia caberioides* Harmer, 1923, p. 335.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Wilhelm II Land (Kluge); Oates Land (Terra Nova)

The specimens of *Amastigia cabereoides* obtained by the 'Terra Nova' consist of a few small fragments, but agree exactly with Kluge's description, except for the scutum which has a larger proximal lobe (Fig. 4 D). The zooecia of the inner series are partially excluded from the basal surface.

This species is closely allied to *A. kirkpatricki*. It differs in possessing scuta, and in its joints which resemble those of other species of *Amastigia*, while those of *A. kirkpatricki* have the structure found in *Scrupocellaria*.

7. *Amastigia vibraculifera* sp.n. Plate VII, fig. 1; Fig. 4 E.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic, Sts. WS 84, WS 85.

GEOGRAPHICAL DISTRIBUTION. Falkland Islands (Discovery).

HOLOTYPE. St. WS 85.

This species is related to *Amastigia cabereoides* Kluge from which it differs in having more numerous series of smaller (particularly shorter) zooecia, with more numerous, stouter spines and pear-shaped scuta directed obliquely backwards, without distinct proximal and distal lobes (Fig. 4 E). The marginal zooecia usually have one inner spine and four outer ones. The inner zooecia have two or sometimes three spines on one side and one on the other. Most branches have four series of zooecia through most of their

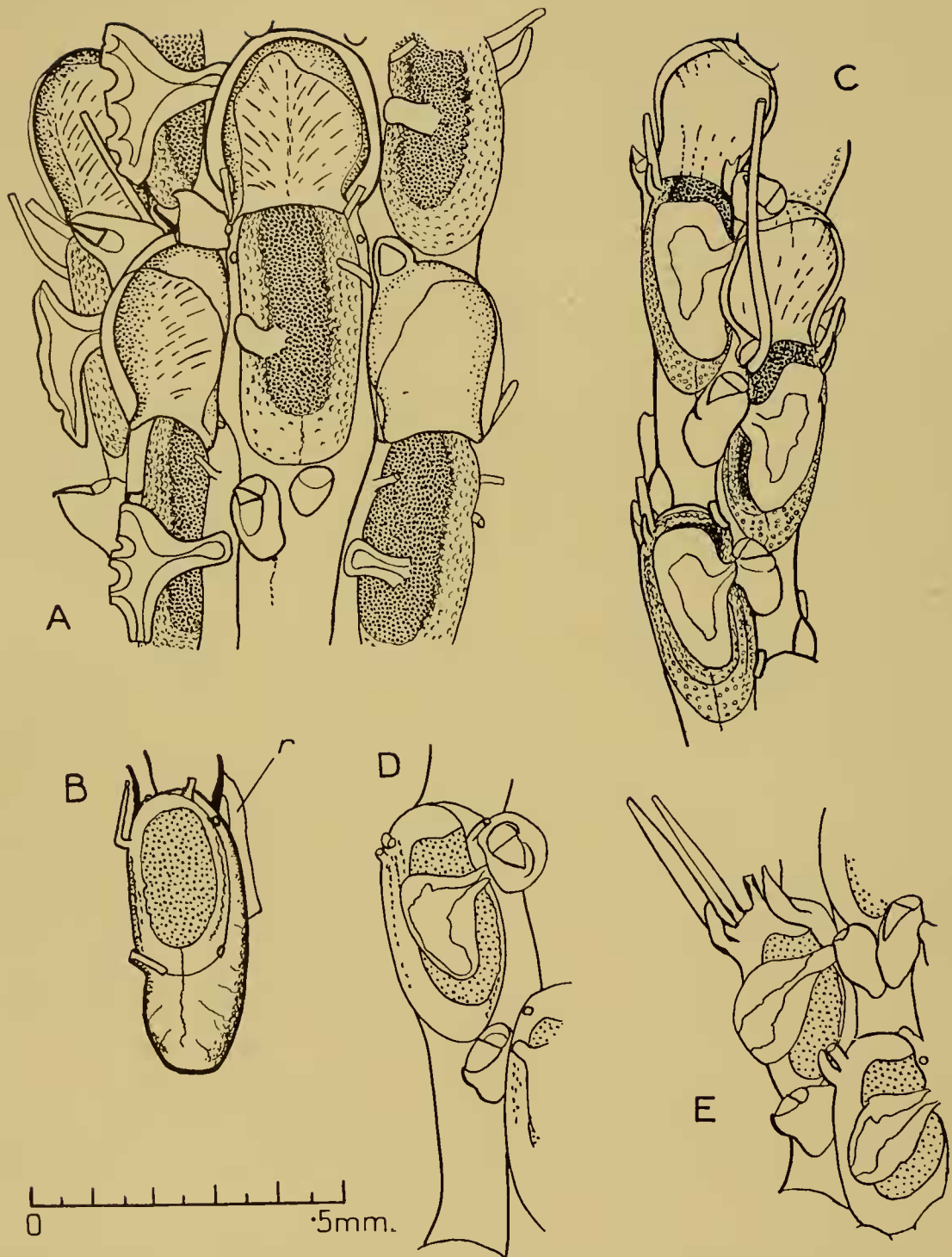


Fig. 4. A, B. *Amastigia solida* (Kluge). St. TN 194, off Oates Land. B. shows an ancestrula in slightly oblique view. C. *A. crassimarginata* (Busk). St. WS 840, between Patagonian Shelf and Burdwood Bank. D. *A. cabereoides* (Kluge). St. TN 194, off Oates Land. E. *A. vibraculifera* sp.n. St WS 85, Falkland Islands. Marginal zoecium and parts of neighbouring zoecia in slightly oblique view.

r. rootlet.

length and some have as many as six. The inner rows of zooecia contribute more to the basal surface than in *A. cabereoides*, and the frontal surface is correspondingly less convex. The branches (Plate VII, fig. 1) thus appear broader and flatter than those of *A. cabereoides*. In other features, including the basal vibracula and the occasional gigantic frontal avicularia, the two species are similar. The ovicells are like those of *A. cabereoides*, as figured by Kluge. The short stout spines, two on the side opposite to the scutum and one on the other, are proximal to the ovicell. The relation of this species to *A. cabereoides* is comparable to that of *A. nuda* to *A. gaussi* (see p. 325).

8. *Amastigia antarctica* (Kluge). Fig. 5 A.

*Anderssonia antarctica* Kluge, 1914, p. 618, pl. xxxiii, figs. 3, 4.

*Amastigia antarctica* Harmer, 1923, p. 338.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (Terra Nova; National Antarctic Expedition).

There are a few fragmentary specimens agreeing very closely with Kluge's description of this species. The basal surface is usually entirely formed by the lateral zooecia, but part of the specimen from the National Antarctic Expedition's winter quarters (no. 10 hole) is 7-serial, and here the median zooecia reach the basal surface forming a broad continuous band. The intermediate series are still completely excluded, or only just visible. In other species of *Amastigia* in which the median and intermediate zooecia are more or less excluded from the basal surface, they take fairly equal shares in the formation of the basal wall, giving a more or less regular lozenge-pattern (e.g. Harmer, 1923, pl. xvii, fig. 24). The ovicells (Fig. 5 A) are rather flatter and straighter sided than those shown by Kluge. The calcified part of the ectooecium forms a narrow band on each side to which the avicularia of the distal zooecium are attached, and the membranous part appears to be continuous with the frontal membrane of the distal zooecium.

As pointed out by Harmer (1923, p. 339), *A. antarctica* is allied to *A. pateriformis* (see below), which is represented in the British Museum by the very small type-colony. In the latter the frontal avicularia, which are unpaired even on the median zooecia, are set very obliquely, or almost transversely, and may be of large, but not gigantic, size. In *A. antarctica* they are paired on the median zooecia and are usually smaller, though the unpaired ones on the lateral zooecia may very much resemble those of *A. pateriformis*. The basal heterozooecium in *A. pateriformis* is placed at the extreme proximal end of the exposed part of the basal wall of the zooecium to which it is attached. In *A. antarctica* the basal wall of the zooecium usually extends a short distance beyond the heterozooecium proximally, as shown by Kluge, and the heterozooecium is smaller, but one specimen (from St. TN 194) has larger, more oblique ones, some of which extend to the proximal end of the exposed part of the basal wall of the zooecium. The median zooecia are not completely excluded from the basal surface of the branch in *A. pateriformis*. It will be seen that none of these differences is absolutely constant,

and *A. antarctica* and *A. pateriformis* may, when better material is available, be found to be synonymous.

9. *Amastigia pateriformis* (Busk).

*Menipea pateriformis* Busk, 1884, p. 22, pl. v, fig. 4, 4 a.

*Amastigia pateriformis* Harmer, 1923, p. 339.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Off Valparaiso, 3953 m. (Busk).

This species is discussed under *Amastigia antarctica* with which it may be synonymous.

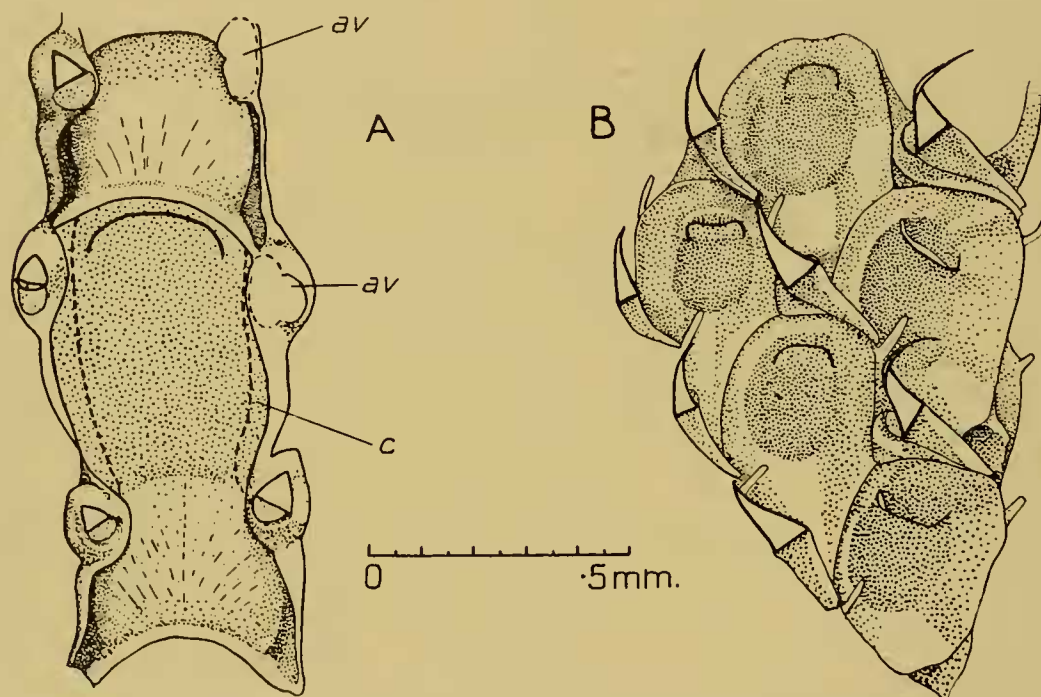


Fig. 5. A. *Amastigia antarctica* (Kluge). National Antarctic Expedition, McMurdo Sound. In the lower ovicell the membranous ectoecium, continuous with the frontal membrane of the distal zooecium, is intact; in the upper it is almost completely destroyed. Edge of cryptocyst indicated by dotted line. B. *Menipea zelandica* sp.n. St. 935, New Zealand.

Both figures drawn from dry specimens seen by reflected light. *av.* avicularium (broken), *c.* cryptocyst.

10. *Amastigia solida* (Kluge). Fig. 4 A, B.

*Scrupocellaria solida* Kluge, 1914, p. 611, pl. xxvii, figs. 7, 8.

*Amastigia solida* Harmer, 1923, p. 338.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Wilhelm II Land (Kluge); Oates Land (Terra Nova).

This species is represented by a few fragments only, but they are quite unmistakable. The spines are attached at the base of the rim of the opesia as shown by Kluge. Ovicells (Fig. 4 A), which were not present on Kluge's material, are to be seen here. The structure in Kluge's fig. 8 which might be mistaken for an ovicell is the projecting rim of the

opesia. The ovicells are usually longer than wide, sometimes more nearly spherical. The ectooecium has faint striations, radiating from a median longitudinal line.

A young colony with ancestrula was obtained at St. TN 194, off Oates Land, on 22 February 1911. It was slung by rootlets. The ancestrula (Fig. 4 B) is of the same type as that of *Amastigia benemunita* but is longer and relatively narrower. The oval opesia has a granular cryptocyst and there are six spines, widely spaced round the opesia so that two are distal and two are on each side, one near the distal and the other near the proximal end of the opesia. The ancestrula gives rise to two zoecia.

11. *Amastigia crassimarginata* (Busk). Fig. 4 C.

*Caberea crassimarginata* Busk, 1884, p. 28, pl. xi, fig. 1.

*Canda crassimarginata* Waters, 1913, p. 480.

*Amastigia crassimarginata* Harmer, 1923, p. 334.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, St. WS 840.

GEOGRAPHICAL DISTRIBUTION. Off Patagonian Shelf, below 400 m. (Busk; Discovery).

This specimen (Fig. 4 C) agrees closely with the type except that the proximal lobe of the scutum is broad.

12. *Amastigia abyssicola* (Kluge).

*Scrupocellaria abyssicola* Kluge, 1914, p. 611.

*Amastigia abyssicola* Harmer, 1923, p. 335.

*Scrupocellaria funiculata* Waters, 1904, p. 23, pl. viii, figs. 1 a, b.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Southern Ocean, 2450 m. (Kluge); Bellingshausen Sea, 2800 m. (Waters).

I have seen no specimen of this species. Its basal heterozoecia are undescribed, and its most characteristic feature appears to be the lobed lumen of the scutum. The cryptocyst is described as wide and granular.

Menipea Lamouroux, 1812

*Key to the species*

1. Zoarium bi- or triserial ... ..	2
Zoarium pluriserial ... ..	9
2. Zoarium triserial, at least in part, ovicells present ... ..	3
Zoarium biserial except for presence of an axillary zoecium, ovicells rudimentary or absent ... ..	4
3. Zoarium mainly biserial, branches keeled frontally, frontal avicularia usually single, cryptocyst with spines ... ..	<i>M. marionensis</i> <sup>1</sup>
Zoarium mainly triserial, branches flat, frontal avicularia often paired on median zoecia, cryptocyst commonly with a median tooth ... ..	5. <i>M. triseriata</i>
4. Opesia occupying whole frontal surface, branch compact straight-sided, spines absent ...	5
Opesia not occupying whole frontal surface, branch neither compact nor straight-sided, spines present ... ..	6

<sup>1</sup> For the species of *Menipea* not discussed in this report see Harmer (1923).

- |  |   |
|--|---|
| 5. Marginal avicularia absent, frontal avicularia present below bifurcation, outer distal corner angular or spike-shaped ... .. . . .              | M. ornata <sup>1</sup>                                    |
| Marginal avicularia present, frontal avicularia absent, outer distal corner rounded ... .. . . .   | 6. M. quadrata  |
| 6. Frontal avicularia columnar, branches curled at tip ... .. . . .  | 1. M. crispa  |
| Frontal avicularia sessile, branches not curled... .. . . .  | 7   |
| 7. Frontal avicularia with setiform mandibles ... .. . . .   | 3. M. flagellifera  |
| Mandibles of frontal avicularia not setiform ... .. . . .  | 8   |
| 8. Ovicells vestigial, cryptocyst granular ... .. . . .  | 4. M. kempfi  |
| Ovicells absent, cryptocyst smooth ... .. . . .  | 2. M. patagonica  |
| 9. Colony bilaminar... .. . . .  | 10  |
| Colony unilaminar ... .. . . .   | 11  |
| 10. Frontal avicularia paired, small, with short mandible, branches straight, wider distally ... .. . . .  | M. roborata <sup>2</sup>                                  |
| Frontal avicularia single, rather large, with long, pointed mandible, branches somewhat curved laterally, not markedly wider distally ... .. . . . | 7. M. zelandica   |
| 11. Basal heterozoocia present at bifurcation and sometimes elsewhere ... .. . . .   | 8. M. vectifera   |
| Basal heterozoocia absent ... .. . . .   | M. ligulata, M. multiseriata, and M. spicata <sup>2</sup> |

### 1. *Menipea crispa* (Pallas).

*Cellularia crispa* Pallas, 1766, p. 71.

*Cellaria cirrata* Ellis and Solander, 1786, p. 29, pl. iv, fig. dD.

*Menipea crispa* Harmer 1923, p. 340, pl. xvii, fig. 17 (synonymy); Hasenbank, 1932, p. 364.

*Menipea cirrata* O'Donoghue, 1924, p. 32; Busk, 1884, p. 22; O'Donoghue and de Watteville, 1937, p. 12.

STATION DISTRIBUTION. *South Africa*: Saldanha Bay.

GEOGRAPHICAL DISTRIBUTION. *South Africa* (Auctt.; Discovery); *Madagascar* (Marcus).

Busk (1879, p. 194) recorded *Cellularia cirrata* from Kerguelen, but his specimens so labelled (99.7.1.664 and 665) belong to *Menipea patagonica*. The record for New Zealand by Gray (1843, p. 292), based on Sinclair's collection, is also erroneous. Three of Sinclair's specimens in the British Museum are labelled *M. cirrhata* [*sic*] in Gray's writing. They belong to *Catenicella umbonata* (42.12.9.23), *C. hastata* (42.12.9.24), and *Tricellaria monotrypa* (42.12.9.25). In the same registration there is also a specimen from Algoa Bay labelled *Menipea cirrhata*, and this proves to be *M. triseriata*. Gray was evidently uncertain of the identity of *M. cirrata*, and this uncertainty persisted for some years, for Busk (1851, p. 119) mentions a *Catenicella* "which is most probably the *Menipea cirrata* of Lamouroux, or the *Cellaria cirrata* of Ellis and Solander". It was presumably on Gray's authority that Hutton (1873, p. 90), who had not seen specimens (see his explanation of asterisk, p. 1), gave *Menipea cirrata* in his list of New Zealand species.

<sup>1</sup> *Cellularia infantae* O'Donoghue (1924, p. 30), of which part of the type material is in the British Museum (23.7.26.1), is a synonym of *Menipea ornata* (Busk).

<sup>2</sup> For the species of *Menipea* not discussed in this report see Harmer (1923).



2. *Menipea patagonica* Busk. Plate V, figs. 1, 2; Fig. 6 A.

*Menipea patagonica* Busk, 1852*b*, p. 22, pl. xxv, figs. 1-3, pl. xxvi, figs. 1, 2 [not pl. xxiii, fig. 1 = *Tricellaria aculeata*]; Busk, 1879, p. 194; Jullien, 1888, p. 71; Calvet, 1904, p. 5; Harmer, 1923, p. 341; Vallentin, 1924, p. 373.

*Scrupocellaria patagonica* Kluge, 1914, p. 615, text-fig. 4.

*Menipea obtusa* Hasenbank, 1932, p. 370, text-fig. 34 A-D.

*Cellularia cirrata* Busk, 1879, p. 194 (not *Cellaria cirrata* Ellis and Solander).

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 222, WS 72, WS 84, WS 87. *Antarctic*: Weddell Quadrant, Sts. 145, WS 25, WS 56, MS 65.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region (Jullien; Calvet; Hamburg Museum, B. 830, B. 979, B. 1205; Discovery); Patagonian Shelf (Busk; Vallentin; Hamburg Museum, B. 812; U.S. National Museum; Discovery); Kerguelen (Busk; Kluge); South Georgia (Hamburg Museum, B. 782; Discovery); Bouvet Island (Hasenbank).

This species is not known from New Zealand, and is included erroneously in Hutton's list of New Zealand Polyzoa (1904, p. 294), the locality not being given in the work quoted by Hutton.

Zooecia with more than two spines are rare, but in most colonies there are a few internodes which have two outer distal spines on the second of the six zooecia. The extra spine takes the place of the marginal avicularium.

As noticed by Busk, there is considerable variation in the shape of the zooecia, slender ones predominating in some colonies. Enlarged marginal avicularia may be almost completely absent from these slender colonies. Colonies are also found in which the more proximal zooecia are very large and long, in quite marked contrast to those composing the more distal branches. The colony from St. WS 72 consists of slender feathery branches, the rest of the Discovery specimens being more shrubby (cf. figs. 1, 2, Plate V). The distal internodes may consist of more than the six zooecia supposed to be characteristic of the species. This is seen in several Falkland Island specimens and in some of Busk's specimens from Kerguelen. Such a branch may end in a biserial internode of as many as five pairs of rather short zooecia (St. WS 72, Falkland Islands). Internodes of either kind may be fertile. The embryo develops in an ovisac in a zooecium whose polypide eventually degenerates. In the earliest stage seen (South Georgia, Hamburg Museum, B. 782), the ovary consists of two fairly small eggs, embedded in a small quantity of tissue, lying in the distal part of the zooecium. One of them increases in size while the other remains almost unchanged and a follicle is formed about them both. Later stages can be seen in another specimen from South Georgia (September 1892, Hamburg Museum, B. 979). The embryos are in advanced stages of segmentation and some are beginning to assume the larval form, the epithelium of the sucker and, where the larva is in a suitable position, the groove of the pyriform organ being visible. The ovisacs are conspicuous, and some are empty. Some polypides are present, but the majority of the zooecia contain brown bodies. Some of the zooecia with an embryo or an empty ovisac also contain one or two small eggs, or one rather larger egg in a follicle, occupying the proximal part of the body cavity. The material taken at St. 145 in January 1927 is at a more advanced stage. Segmentation stages are absent, and polypides are

exceedingly rare, while empty ovisacs and embryos showing larval structure are present in considerable numbers.

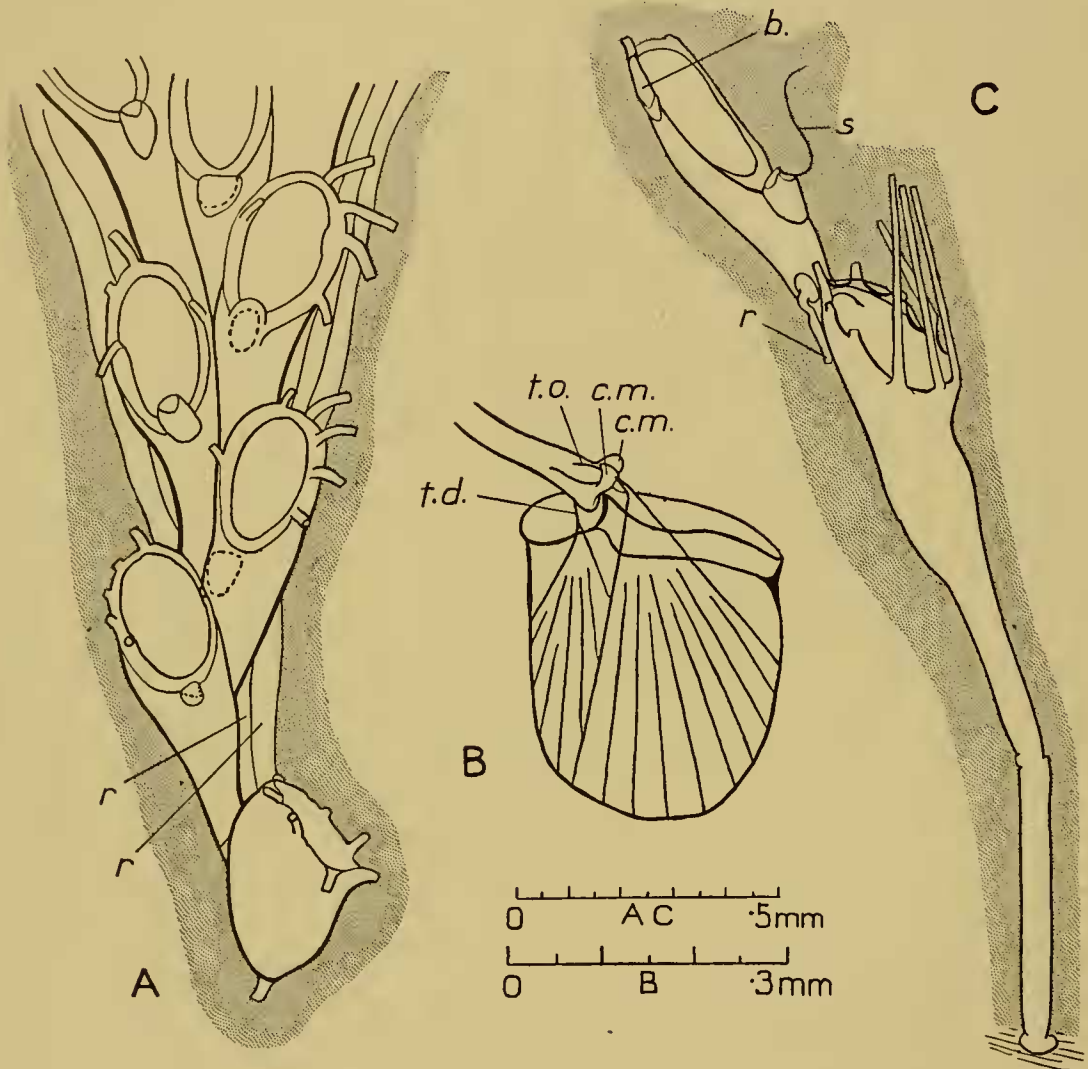


Fig. 6. A. *Menipea patagonica* Busk. 99.7.1.715 (Eaton Collection), Kerguelen. Young colony with ancestrula, drawn from a dry specimen seen by reflected light. B. *M. flagellifera* Busk. St. WS 84, Falkland Islands. To show musculature of frontal avicularium. C. *M. flagellifera* Busk. St. 1563, Marion Island. Ancestrula and first zoecium.

*b.* bud, *c.m.* condyles of mandible, *r.* rootlet, *s.* seta, *t.d.* tendon of divaricator muscle, *t.o.* tendon of occlusor muscle.

Busk (1879, p. 194) recorded specimens of this species as *Cellularia cirrata* (see p. 332). Hasenbank's description and figure of *Menipea obtusa* agree so exactly with *M. patagonica*, of which I have examined the type material, that there can be no doubt that they are synonymous.

Busk's figure (1852*b*, pl. xxiii, fig. 1), purporting to represent the ancestrula and first few zoecia of this species, was drawn from a specimen of *Tricellaria aculeata* (see

p. 358). A specimen of *Menipea patagonica* from Swain's Bay, Kerguelen (Busk Collection, 99.7.1.715) does, however, show the ancestrula (Fig. 6 A). It is taller than that of *Tricellaria aculeata* and attached by its tubular tip. The first internode is separated from it by a joint, and consists of seven zooecia, of which the first two have five spines arranged along the outer and distal borders of the rather short opesia and one on the inner border. The other five zooecia have successively fewer spines and a longer opesia. The succeeding internodes are typical. In two colonies from the Falkland Islands lent by the U.S. National Museum the first few zooecia are similar to those just described, but the assumption of typical characters is more gradual, so that several internodes consist of rather shorter zooecia with more than the usual number of spines. The ancestrula has broken away in both.

### 3. *Menipea flagellifera* Busk. Figs. 6 B, C, 7 C.

*Menipea flagellifera* Busk, 1884, p. 21, pl. iv, fig. 1; Calvet, 1904, p. 6; Harmer, 1923, p. 343.

*Scrupocellaria flagellifera* Kluge, 1914, p. 615, text-fig. 5.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 79, WS 81, WS 82, WS 84, WS 85, WS 87, WS 88, WS 220, WS 225, WS 228, WS 231, WS 237, WS 239, WS 243, WS 244, WS 245, WS 246, WS 824, WS 838, WS 871; South Indian Ocean, Sts. 1562, 1563, 1564.

GEOGRAPHICAL DISTRIBUTION. Patagonian Shelf (Busk; Calvet; Discovery); off Patagonian Shelf, down to 339 m. (Discovery); Marion Island (Busk; Discovery); Prince Edward Island (Discovery); Kerguelen (Busk; Kluge).

The setiform mandible of the frontal avicularium has a thickened base, which would be more or less triangular in cross-section, and has its corners drawn out to form massive condyles (Fig. 6 B). The divaricator and oclucosor muscles appear to be unpaired and are attached to opposite surfaces of the mandible, medianly and at a little distance from its base, the tendon of the oclucosor muscle passing between the condyles. The setiform mandible with its massive condyles gives this heterozooecium a strong superficial resemblance to a vibraculum, but it appears to be almost symmetrical in structure (the condyles differ a little in shape), and to have only a symmetrical two-way movement of the mandible, and is therefore, as Harmer also concluded, an avicularium.

Fertile zooecia are to be seen in material collected at St. 1564 (Prince Edward Island, 7 April 1935), but are not numerous. The embryo occupies a large sac in the body-cavity and the ovicell is represented by a small cap at the distal end of the zooecium, the cryptocyst being interrupted at this point (Fig. 7 C).

There are ancestrulae of this species from Sts. 1563 and 1564 (Marion and Prince Edward Islands, 7 April 1935). The ancestrula is of the "vase-shaped" type with oblique distal opesia surrounded by spines. It is chiefly remarkable for the length of its stalk-like proximal part (Fig. 6 C). The suggestion of a joint in this part in the figured specimen is due to an accidental kink. The ancestrula is attached by a small disk. The characteristic frontal vibraculum is present on the first zooecium budded from the ancestrula.

4. *Menipea kemp* sp.n. Fig. 7 A, B.STATION DISTRIBUTION. *Sub-Antarctic*: South Indian Ocean, Sts. 1562, 1563.

GEOGRAPHICAL DISTRIBUTION. Marion Island (Discovery).

HOLOTYPE. St. 1562.

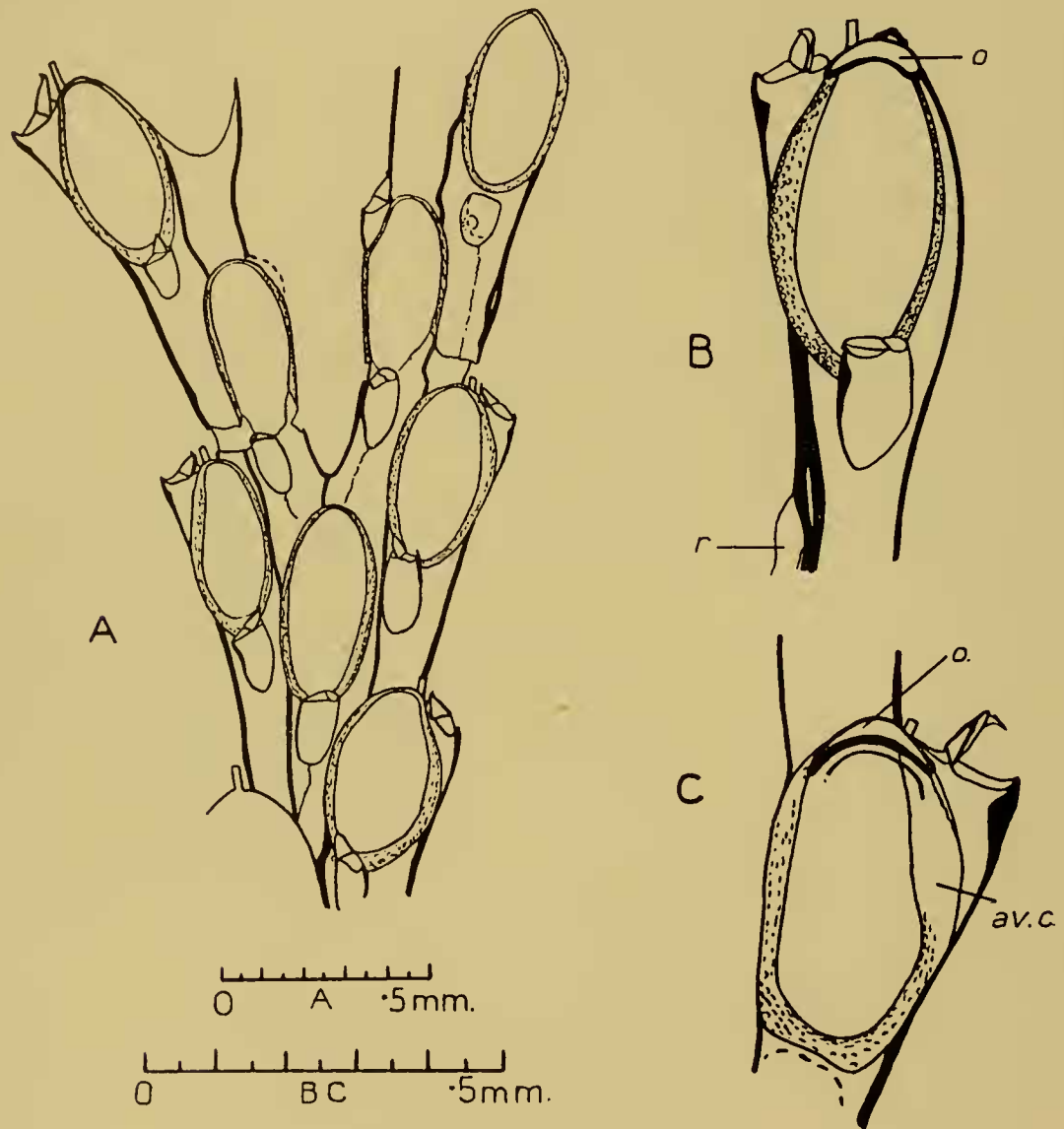
DESCRIPTION. *Zoarium* biserial with bifurcation of Harmer's type 17 (Fig. 7 A).*Zooecia* with oval opesia occupying not more than half total length, with narrow tuberculate cryptocyst of uniform width except at distal end where it is narrower.

Fig. 7. A, B. *Menipea kemp* sp.n. St. 1562. Marion Island. A. Bifurcation. B. Fertile zooecium. The little thick-walled chamber above the ovicell is not constantly present. C. *M. flagellifera* Busk. St. 1564. Prince Edward Island. Fertile zooecium. The position of the frontal avicularium is indicated with a dotted line. *av.c.* chamber of marginal avicularium, *o.* ovicell, *r.* rootlet.

*Spines*: one very small spine on basal surface of outer distal corner, between marginal avicularium and distal zooecium, as in *Menipea flagellifera*.

*Avicularia*: frontal and marginal, constantly present, with well-developed beak.

*Ovicells* (Fig. 7 B), cap-like, embryo developing in large ovisac in body cavity.

REMARKS. This species is most nearly related to *M. flagellifera*, which it resembles in the general form of its colony and zooecia, in its granular cryptocyst and in its cap-like ovicells. It differs in its frontal avicularia which have a short triangular mandible. The avicularian chamber of *M. kempfi* is not unlike that of *M. flagellifera* in outline, but it projects more, having a raised and prominent beak. The differences between the flagelliform mandible of the one species, with its basal condyles, and the small triangular mandible of the other, are constant and very pronounced. The marginal avicularia of *M. kempfi* are somewhat turned towards the frontal surface.

*M. kempfi* also resembles *M. patagonica*. It differs chiefly in the possession of ovicells, however small, *M. patagonica* having similar embryo sacs but no trace whatever of ovicells. *M. kempfi* also differs from *M. patagonica* in its granular cryptocyst; in its shorter opesia; in its frontal avicularia which are larger with a more strongly developed beak; in the greater variability in the number of zooecia composing the internodes, and the greater distance of the joints from the axil; and in the very small size of the outer distal spine and the absence of the inner one. The marginal avicularia of *M. patagonica* tend to have their beak turned obliquely towards the frontal surface, but in *M. kempfi* this position is more marked and the avicularia are less variable in size.

##### 5. *Menipea triseriata* Busk.

*Menipea triseriata* Busk, 1852*b*, p. 22, pl. xxiii, figs. 2-4; Hasenbank, 1932, p. 367, text-fig. xxxii A-F (references).

*Cellularia triseriata* O'Donoghue, 1924, p. 31; O'Donoghue and de Watteville, 1937, p. 13.

STATION DISTRIBUTION. *South Africa*: Saldanha Bay.

GEOGRAPHICAL DISTRIBUTION. *South Africa* (Auctt.; Discovery).

##### 6. *Menipea quadrata* (Busk).

*Cellularia quadrata* Busk, 1884, p. 18, pl. v, figs. 5-5*b*.

*Menipea quadrata* Harmer, 1923, p. 342.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. *Kerguelen*; *Heard Island* (Busk).

##### 7. *Menipea zelandica* sp.n. Plate V, figs. 3, 5; Figs. 5 B, 8 A.

STATION DISTRIBUTION. *New Zealand*: Sts. 933, 935.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Discovery).

HOLOTYPE. St. 935.

DESCRIPTION. *Colony* dichotomous, bilaminar, slung by rootlets, unjointed, except that some branches are cracked at their base and remain connected by rootlets (Plate V, fig. 3).

*Branches* flattened, twelve series of zooecia maximum observed.

*Rootlets* originating from marginal zooecia, emerging on frontal surface and running down edges of branches, forming bundles.

*Zooecia* with a single marginal spine on one or both sides at some distance from distal end (Fig. 5 B). *Opesia* oval, cryptocyst wide, steeply descending, granular,

gymnocyte almost covered by single frontal avicularium. Oral shelf broad (Plate V, fig. 5). Basal wall more or less narrow, absent in one or two marginal rows (Fig. 8 A) where zoecia are triangular in transverse section. Marginal zoecia drawn out laterally, zoecia of inner series symmetrical.

*Frontal avicularia* (Fig. 5 B) graded in size from the margins to the centre of the branch, largest on marginal zoecia, all directed obliquely proximally and towards the nearest edge of the branch, beak slightly raised, curved or straight, mandible rather long and sharply pointed.

*Ovicells* unknown.

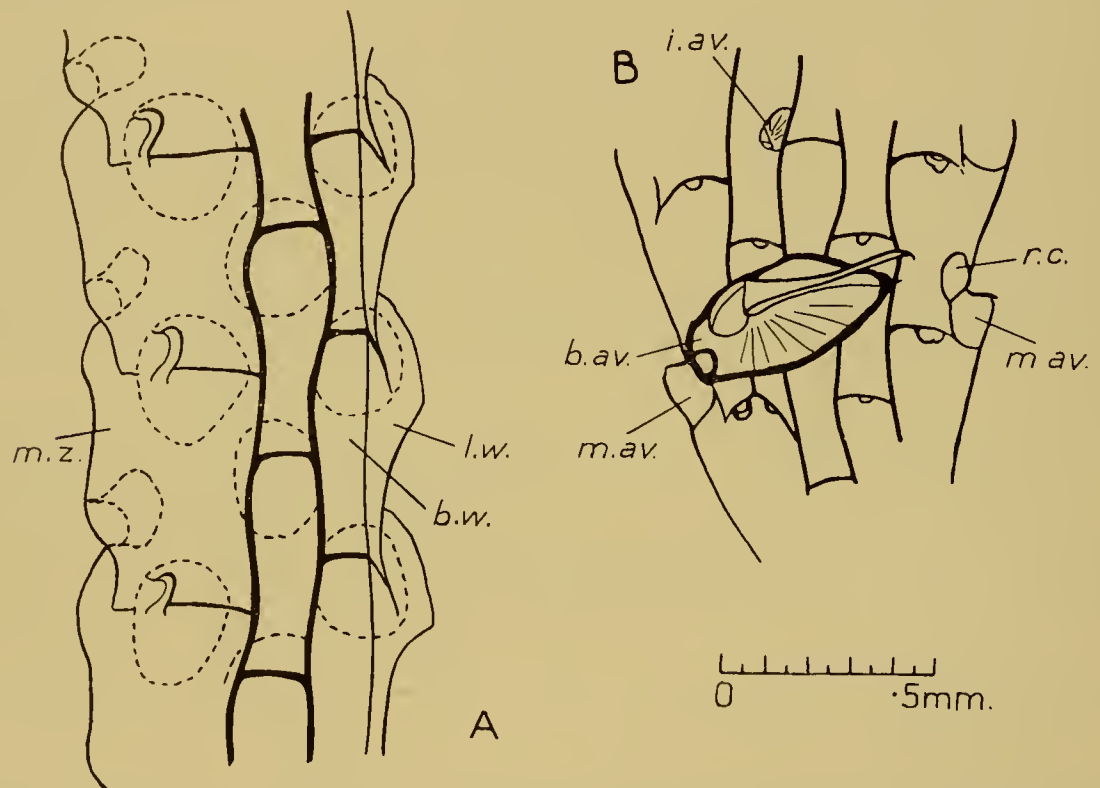


Fig. 8. A. *Menipea zelandica* sp.n. St. 935, New Zealand. The three marginal series of zoecia, separated from the rest by eau de javelle, in basal view. Opesia and rootlet-chambers shown with dotted line. B. *M. vectifera* Harmer. St. 929, New Zealand. Large basal avicularium at intercalation of new series of zoecia with underlying zoecia outlined.

*b.av.* basal avicularium, *b.w.* basal wall of zoecium of inner series, *i.av.* internal avicularium, *l.w.* lateral wall of inner series, *m.av.* marginal avicularium, *m.z.* marginal zoecium, *r.c.* rootlet-chamber.

REMARKS. This species resembles *Menipea roborata* (Hincks), which is also bilaminate, in the shape of the zoecia and of their cryptocyst and oral shelf, in the spines, and the rootlets. The frontal avicularia are unpaired and larger; the rootlet chambers are larger and the zoecia are distinctly larger. The branches show less terminal widening and are frequently curved, cf. the straight or concave margins of the branches of *M. roborata* in Plate V, fig. 4 and the curved branches with one margin convex and the other concave to the right of the colony of *M. zelandica*, Plate V, fig. 3.

The frontal origin of the rootlet in this species and *M. roborata* is doubtless correlated with the absence of any exposure of the lateral and basal walls in a bilaminar colony. It is rather more pronounced in *M. zelandica* than in *M. roborata*.

8. *Menipea vectifera* Harmer. Fig. 8 B.

*Menipea vectifera* Harmer, 1923, p. 346, pl. xvii, fig. 23, pl. xviii, figs. 36-39.

STATION DISTRIBUTION. *New Zealand*: Sts. 929, 935.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Harmer; Discovery); Palliser Bay, Wairarapa, *New Zealand* (90.5.27.95).

This material agrees very exactly with Harmer's description and the British Museum specimens, except that in addition to the basal avicularia at the bifurcation there are others of similar shape but much greater size on other parts of the basal surface (Fig. 8 B). These large avicularia are placed transversely and may extend across as many as five series of zooecia. The figured example is not one of the largest. It seems that both kinds of basal avicularia are associated with the formation by one zooecium of a pair of distal buds. Where one of the inner series is duplicated in this way it invariably, as far as my observations go, leads to a bifurcation and not to increase in the number of series in the branch. The axillary avicularium appears to originate on the common lateral wall of the two daughter zooecia and overlies parts of the basal surface of both. The number of series in a branch seems to be increased solely by the marginal zooecia, the inner of a pair of distal buds forming an additional inner series of symmetrical zooecia, the outer bud continuing the marginal series of asymmetrical zooecia. It is at these points that the large basal avicularia are found, originating from the outer of the two daughter zooecia and overlying the inner of the two, and two or three more inner series. Basal avicularia have not been found except in association with paired buds, but such duplications do occur without formation of avicularia.

*Notoplites* Harmer, 1923

The definition of *Notoplites* Harmer (1923, p. 348) must be modified to admit uniserial colonies with lateral branches (see *N. tenuis* var. *uniserialis*, p. 351).

There are eight species and one variety of *Notoplites* in these collections, falling into two groups of closely related forms: the *N. antarcticus* group, comprising *N. antarcticus*, *N. watersi*, *N. drygalskii* and *N. vanhoeffeni*; and the *N. elongatus* group, comprising *N. elongatus*, *N. tenuis*, *N. klugei* and *N. crassiscutus*.

The four species of the *N. antarcticus* group all possess the internal spines noticed by Waters in *N. antarcticus*. One projects from the proximal wall in most zooecia, and its tip is divided into two or three points which may be curved and hooked (see *N. drygalskii*, Fig. 9 A). It is sometimes hidden in frontal view by the overlapping of the proximal zooecium and the corresponding obliquity of the wall from which the spine springs. *N. perditus* may belong to this group, see p. 355.

In three of the four species of the *N. elongatus* group (*N. elongatus*, *N. tenuis* and *N. crassiscutus*) there may be an oval, apparently thinner, area in the outer lateral wall

of the zooecium, sometimes with a linear series of smaller similar areas proximal to it (Figs. 14 A-C, 16 B). They can be seen to be the points of attachment of the opercular and parietal muscles, but they are not apparent in young zooecia, presumably owing to the less advanced calcification. They are more conspicuous, when present, in *N. tenuis* than in the other two species. They have not been seen in *N. klugei*, but the specimen is not in very satisfactory condition for seeing them. Nor have they been seen in the species of the *N. antarcticus* group, that part of the wall being covered by the marginal avicularium. They are not peculiar to species of *Notoplites*. They are present, for example, in *Camptoplites areolatus* (Kluge) and *Amastigia kirkpatricki* Harmer, and Busk figured them (1852 b, pl. xxvii, fig. 4) in *Tricellaria peachii*.

The ancestrulae are known in only four of the species, two from each group, but it is perhaps worth noticing that the two from the *elongatus* group are short (slipper-shaped) and give rise to a single zooecium, the branch becoming biserial subsequently, but that in the two from the *antarcticus* group the ancestrula is tall (vase-shaped) and gives rise to a pair of zooecia (cf. Figs. 13 A, C and 11 A, B). On the other hand, ancestrulae resembling those of *N. elongatus* and *N. tenuis* are found in species belonging to other genera of the Scrupocellariidae, e.g. in *Tricellaria aculeata* (see p. 358).

*Key to the species of Notoplites in the collection*

- |  |     |     |     |     |     |     |     |     |     |     |     |     |   |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|
| 1. Colony biserial   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2   |
| Colony uniserial   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 8. <i>N. tenuis</i> var. <i>uniserialis</i> var. n. |
| 2. Internal spines present, marginal avicularia conspicuous, ectooecium with small uncalcified area <sup>1</sup>   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3   |
| Internal spines absent, marginal avicularia relatively small, or absent, ectooecium largely uncalcified  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 6   |
| 3. Frontal avicularium inclined towards neighbouring zooecium  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4   |
| Frontal avicularium inclined away from neighbouring zooecium   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 5   |
| 4. Scutum covering opesia (with rare exceptions), not S-shaped, its proximal lobe broad, branches stout  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3. <i>N. drygalskii</i>                             |
| Scutum not covering opesia, more or less S-shaped, both lobes narrow, branches slender   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1. <i>N. antarcticus</i>                            |
| 5. Distal border of scutum oblique, operculum set obliquely, branches slender  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2. <i>N. watersi</i>                                |
| Distal border of scutum transverse, operculum set transversely, branches stout   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4. <i>N. vanhoeffeni</i>                            |
| 6. Scuta, spines and marginal avicularia absent, joints incomplete or absent   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9. <i>N. klugei</i>                                 |
| Spines and scuta present on at least some zooecia, marginal avicularia present or absent, joints constantly fully developed                                | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 7   |
| 7. Scutum covering opesia, with indented or reduced lumen, basal or marginal avicularia, or both, present  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 8   |
| Scutum not covering opesia, lumen extensive and not indented, basal and marginal avicularia absent   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 7. <i>N. tenuis</i>                                 |
| 8. Small marginal avicularia present, scutum not thickened, its lumen variously indented, cryptocyst smooth, basal avicularia in axil when present, curved | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9   |
| Marginal avicularia absent, scutum thickened and radially striated, its lumen reduced, cryptocyst granular, basal avicularia proximal to axil, flat        | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 10. <i>N. crassiscutus</i>                          |

<sup>1</sup> *N. perditus*, which I have not seen, may come into this group.



9. Basal avicularia absent, distal border of aperture of fertile zoecium smooth 5. *N. elongatus*  
 Axillary basal avicularia present, distal border of aperture of fertile zoecium beaded  
 6. *N. elongatus* var. *calveti*

1. *Notoplites antarcticus* (Waters). Figs. 9 D, 10 C, 11 B.

*Scrupocellaria antarctica* (part) Waters, 1904, p. 25, pl. i, fig. 5 a-e.

*Scrupocellaria antarctica* Kluge, 1914, p. 606, pl. xxviii, fig. 1.

*Notoplites antarcticus* Harmer, 1923, p. 352.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 39, 42, 148, 158, 160, 181, 187, 1948, WS 42.

GEOGRAPHICAL DISTRIBUTION. South Georgia (Shackleton-Rowett Expedition; Discovery); Shag Rocks; near Elephant Island; Palmer Archipelago (Discovery); Bellingshausen Sea (Waters); Wilhelm II Land (Kluge); Oates Land (Terra Nova).

Kluge shows smooth ovicells in *Notoplites antarcticus*, but in these specimens, which otherwise agree very closely with his restricted definition, the ovicells are sculptured as in Waters's figure. The sculpture is chiefly peripheral, and particularly lateral, and consists of papillae on the outer surface of the entoecium, and less numerous lumps and projections on the inner surface of the ectoecium, some of the projections from the two surfaces being opposite and meeting tip to tip (Fig. 10 C). There are also small thin patches in the ectoecium. The "gefelderte" sculpture of the ovicell of *N. watersi* consists of larger and more numerous, but otherwise similar, thin areas in the ectoecium, internal sculpture being only very slightly developed. The ovicell of *N. antarcticus* is shorter and more prominent than that of *N. watersi*. Internal spines are developed in the zooecia (see p. 339).

The scutum is rather variable within the colony, and, despite Kluge's statement that the proximal lobe is rounded, may be quite pointed in otherwise typical specimens. In part of the material from St. 1948 the proximal lobe is pointed and strongly curved, its tip overlapping the inner lateral edge of the opesia (Fig. 9 D). In these specimens some of the frontal avicularia are small and directed frontally as in the figure; others are typical. Zooecia with two distal spines are also not uncommon in this material, sometimes on zooecia with no marginal avicularium, as noticed by Kluge, but also on zooecia that have the avicularium.

Five ancestrulae, believed to belong to this species, have been found in the Discovery collection, from St. WS 42, 7 January 1927; St. 1948, 4 January 1937; St. 187, 18 March 1927. They are erect and vase-shaped (Fig. 11 B); the attachment is almost tubular; the opesia is distal and oblique; two zooecia are budded from the distal end of the ancestrula and no joint is formed. The first zoecium has a scutum, a small marginal avicularium and two or three spines, and sometimes a small frontal avicularium, directed frontally. Where unbroken the scutum of the first zoecium has the form characteristic of the species. The rest of the zooecia successively approach more nearly to the typical specific form, but the larger frontal avicularia, leaning towards the neighbouring zoecium, evidently do not appear till a fairly late stage. The largest of

these young colonies has eight zooecia, and the frontal avicularia are all small and directed frontally.

2. *Notoplites watersi* (Kluge).

*Scrupocellaria watersi* Kluge, 1914, p. 607, pl. xxviii, fig. 2.

*Scrupocellaria antarctica* (part) Waters, 1904, p. 25.

*Notoplites watersi* Harmer, 1923, p. 353.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Bellingshausen Sea (Waters); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition).

The bifurcation of *Notoplites watersi* is of the normal type for the genus, as suspected by Harmer. Internal spines are present (see p. 339).

The angular outline of the branches of *N. antarcticus* and the straighter appearance of those of *N. watersi*, which are shown in Kluge's figures, but not mentioned in his comparison, are sufficiently marked to make it possible to sort a mixture of the two species without magnification. The relation of this species to *N. antarcticus* resembles in some ways that of *N. vanhoeffeni* to *N. drygalskii*, as may be seen from the key, and in each pair one species is widely distributed in the Antarctic region including South Georgia, and the other has been found much less abundantly and only in the far south (see p. 479), where, however, all four species may be found together (e.g. at St. TN 194 off Oates Land).

3. *Notoplites drygalskii* (Kluge). Plate VI, fig. 6; Figs. 9 A-C, 11 A.

*Scrupocellaria drygalskii* Kluge, 1914, p. 609, pl. xxvii, fig. 5.

*Notoplites drygalskii* Harmer, 1923, p. 352; Livingstone, 1928, p. 25 (synonymy).

*Menipea funiculata* Thornely, 1924, p. 6.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 27, 42, 123, 140, 144, 148, 152, 175, 177, 181, 187, 363, 366, 371, 1872, WS 25, WS 27, WS 33; Victoria Quadrant, Sts. 1652, 1658, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia; South Sandwich Islands; near Elephant Island; South Shetland Islands; Palmer Archipelago (Discovery); Adelie Land; Queen Mary Land (Livingstone); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition); Terra Nova; Discovery).

As mentioned above *Notoplites drygalskii* and *N. vanhoeffeni* are related, but clearly distinct, species. In *N. vanhoeffeni* the aperture is narrowed behind the orifice by a projection of the border on each side (Figs. 10 A, B); the scutum has a straight transverse distal border and the operculum is placed symmetrically in the frame so formed. In *N. drygalskii* the aperture is not contracted, the outer border bearing little or no projection, the operculum is obliquely placed and the edge of the scutum is correspondingly oblique (Fig. 9 A), but the operculum is not so closely framed. The obliquity is especially pronounced in non-fertile zooecia (Figs. 9 A, B). The difference in inclination of the frontal avicularia is constant. The marginal avicularium is more distally placed in *N. drygalskii* (cf. Figs. 9 A-C, 10 A, B, and Kluge's pl. xxvii, figs. 5, 6). The ovicells in *N. drygalskii* are immersed in the distal zooecium (Fig. 9 B). Those of

*N. vanhoeffeni*, though they are probably equivalent in their morphology, project more from the branch both frontally and laterally, being larger and more rounded (Fig. 10A). This gives a distinctly different appearance to the fertile branches of the two species, but the non-fertile branches also differ so distinctly that a mixture of the species can be

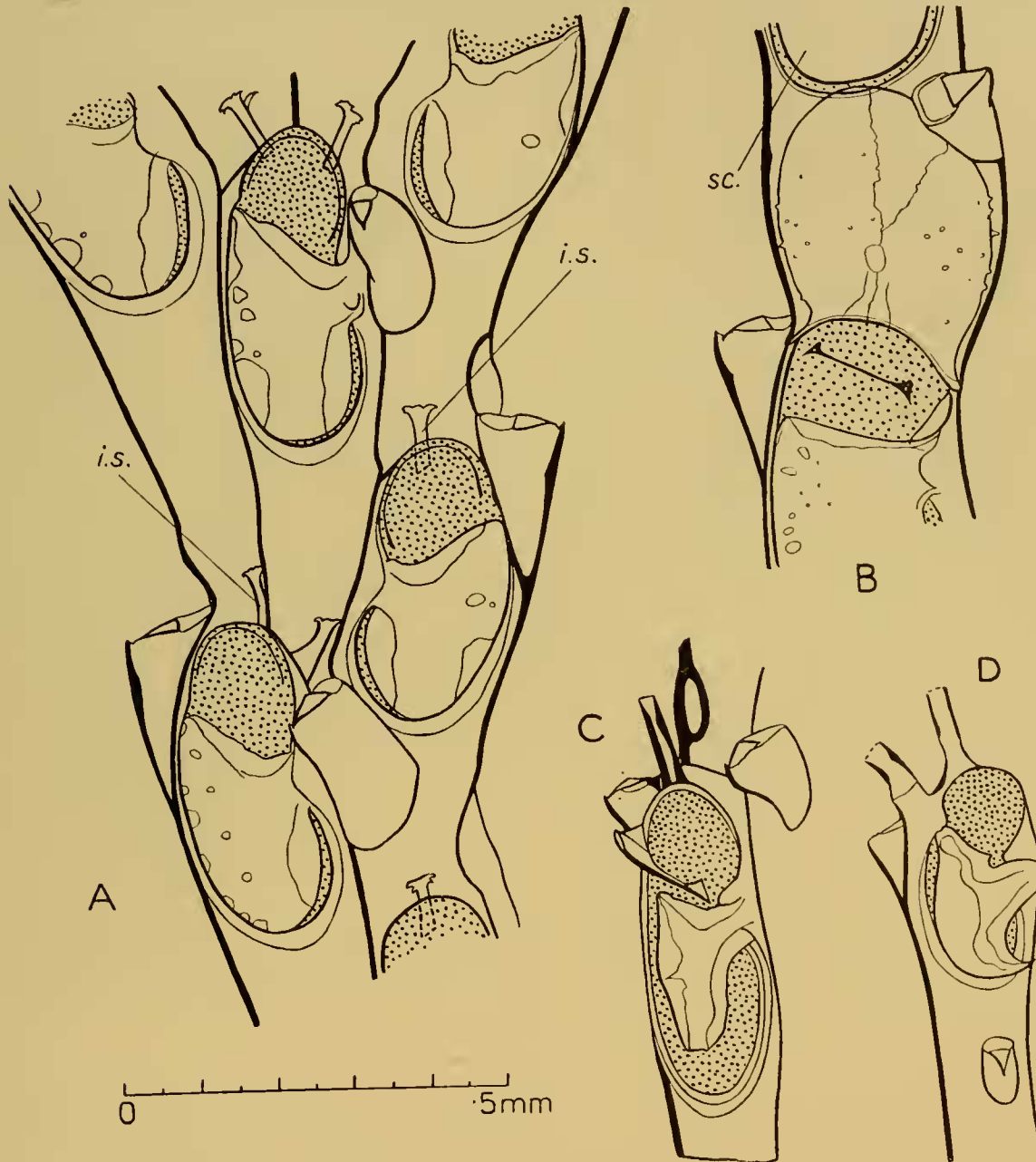


Fig. 9. A. *Notoplites drygalskii* (Kluge). St. WS 27, South Georgia. To show internal spines (attached to oblique distal wall) and differences in orifice from *N. vanhoeffeni* (cf. Fig. 10 B). In some specimens the distal wall is farther from orifice. B. *N. drygalskii* (Kluge). St. TN 331, Ross Sea. Ovicell and adjacent structures. The operculum is open. C. *N. ?drygalskii* (Kluge). St. TN 194, off Oates Land. One zoecium showing abnormal scutum. Slightly oblique view. Operculum open. D. *N. antarcticus* (Waters). St. 1948, near Elephant Island. One zoecium.

*i.s.* internal spine, *sc.* scutum.

sorted without magnification. *N. vanhoeffeni* has stouter branches with a more serrated outline due to the difference in shape of the majority of the marginal avicularia (cf. Figs. 9 A-C and 10 A, B). These not only differ in outline but have their mandibular surface tilted more towards the frontal surface of the branch. All this is shown in Kluge's figures.

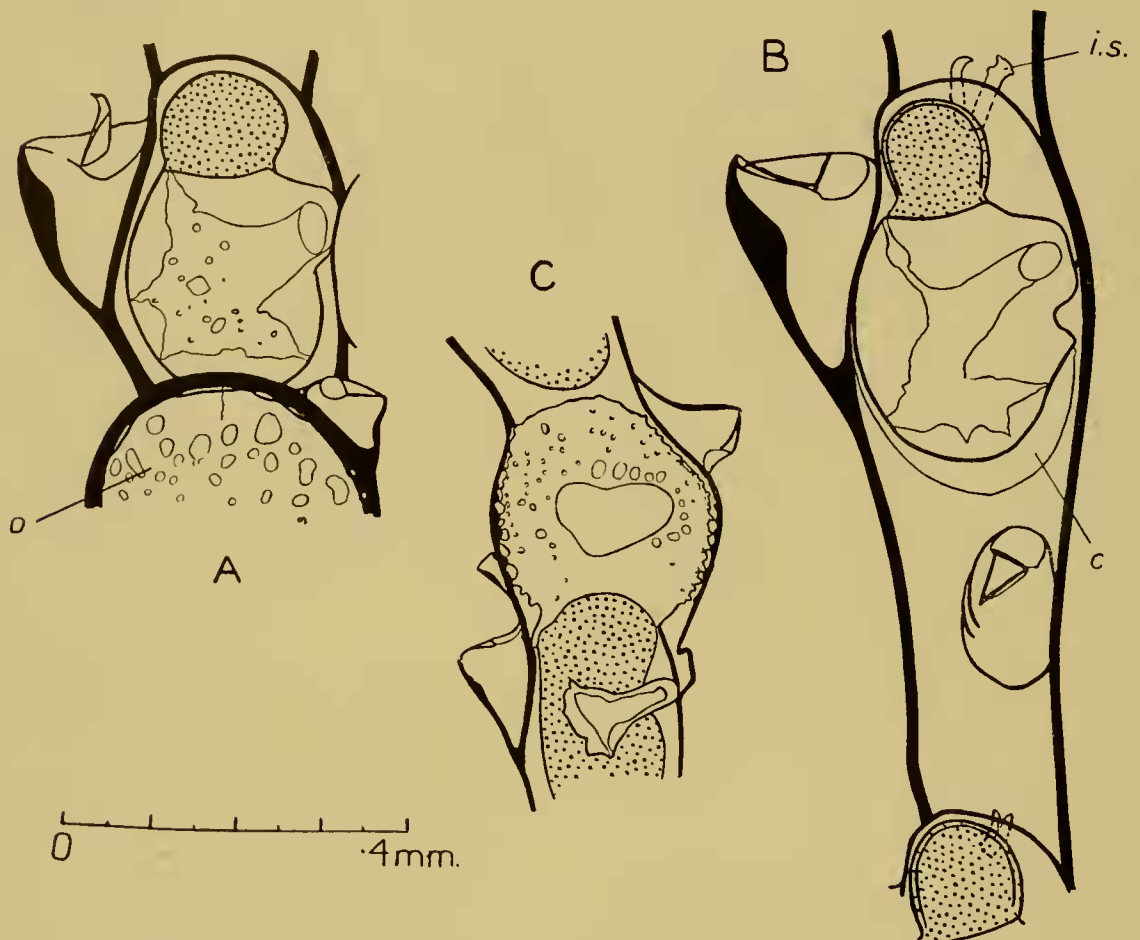


Fig. 10. A. *Notoplites vanhoeffeni* (Kluge). St. TN 348, McMurdo Sound. One zoecium to show scutum with 'islands'. Part of the ovicell of the proximal zoecium is also shown. B. *N. vanhoeffeni* (Kluge). St. TN 339, Ross Sea. To show branched internal spines and differences in orifice from *N. drygalskii* (cf. Fig. 9 A). C. *N. antarcticus* (Waters). St. 39, South Georgia. Ovicell and adjacent structures. The scutum is not normal, cf. normal scutum shown in Fig. 9 D.

*c.* cryptocyst, *i.s.* internal spine, *o.* ovicell.

The ovicells of *N. vanhoeffeni* are always sculptured, those of *N. drygalskii* are usually smooth, but occasionally (e.g. from St. TN 331) there are little papillae on the entoecium giving the ovicell a sparsely punctate appearance (Fig. 9 B).

The frontal avicularia vary in size, and there is some variation in the pattern of the scutum. In *N. drygalskii* there may be "granulation" as in Kluge's specimens or these markings may be larger and more irregular as in the specimen figured (Fig. 9 A). In either case they appear to be interruptions, "islands" one might call them, in the lumen, not granulations of the surface of the scutum. In *N. vanhoeffeni* the lumen is less ex-

tensive and more or less branched (Fig. 10 B), as in Kluge's figure, and "islands" are only very exceptionally present (Fig. 10 A).

The zooecia of *N. drygalskii* may be longer than shown by Kluge, with a corresponding elongation of the opesia. In such specimens the distal spine is commonly absent, and when present is small. In all these characters there is considerable variation within the colony.

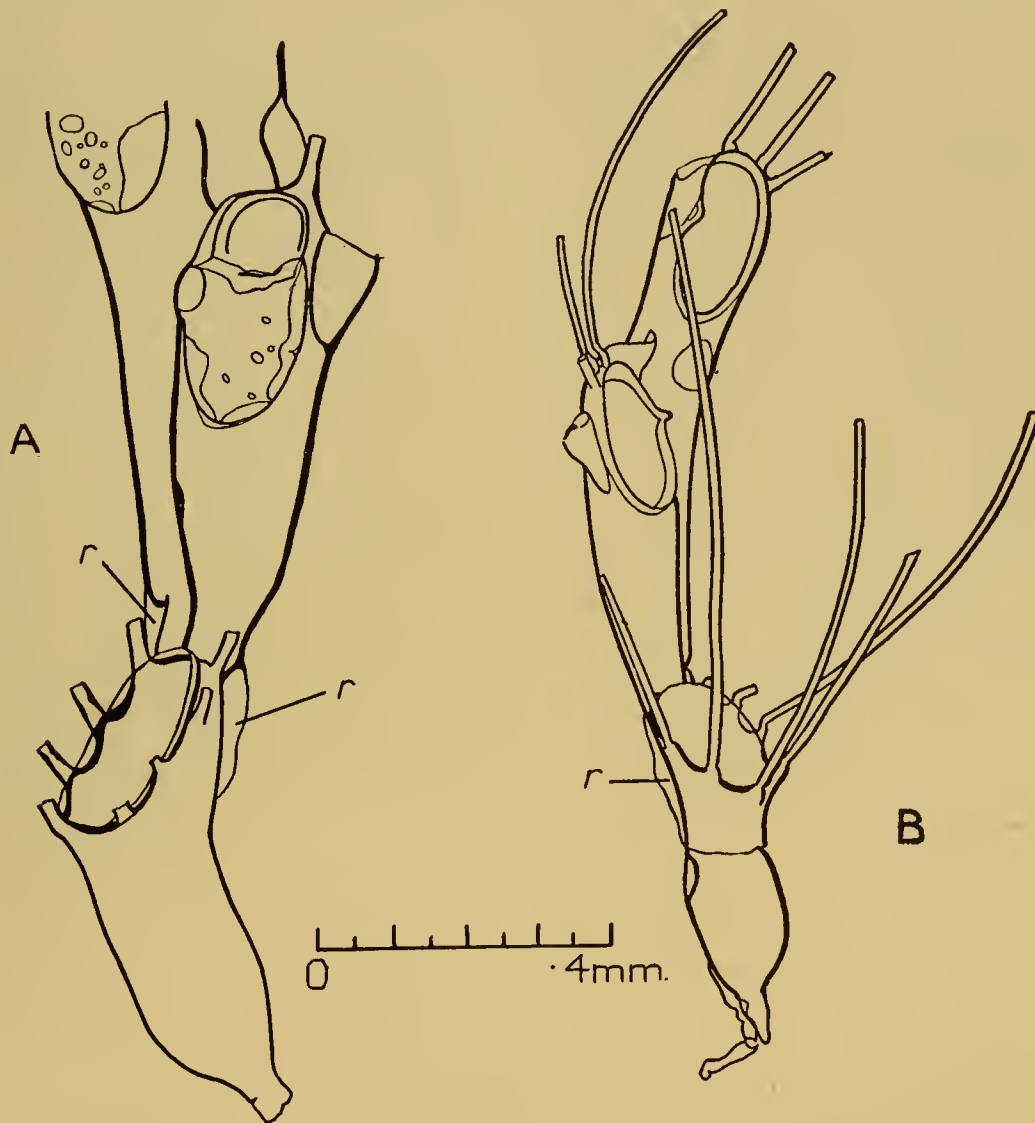


Fig. 11. A. *Notoplites drygalskii* (Kluge). National Antarctic Expedition. McMurdo Sound. Showing ancestrula. B. *N. antarcticus* (Waters). St. WS 42, South Georgia. Showing ancestrula.  
r. rootlet.

Certain specimens in the Terra Nova collection differ from typical *N. drygalskii* in their scuta. Both distal and proximal lobes are shorter and narrower, and the lumen is narrow and more or less bifid, and has no "islands" (Fig. 9 C). In typical specimens the scuta cover the opesia, except for the area occupied by the operculum, and their

oblique distal border closely follows the hinge line of the opercular valve. Most of the aberrant scuta are worn and chipped, but the differences in the lumen are such that they could not be derived from normal ones merely by wear. The difference is definite, and there appear to be no intermediate specimens, but as no other distinction has been noticed and the variability of scuta is well known, I have not separated these specimens from *N. drygalskii*. In the material from St. TN 194 the two forms are present in almost equal quantities, and St. TN 339 also yielded both. From St. TN 316 only the aberrant type was obtained.

*N. drygalskii* seems to be much more common than *N. vanhoeffeni* in the regions in the far south visited by the 'Discovery', as well as being found at South Georgia where *N. vanhoeffeni* has not been recorded. At St. 1652 (Ross Sea) the 'Discovery' obtained fifteen luxuriant colonies of *N. drygalskii*. The largest was 16 cm. long and 11 cm. across at its thickest point (Pl. VI, fig. 6), and several of the others were only a little smaller. In each colony the rootlet bundles form quite a stout stalk, ending in a tuft of rootlets to which little black stones and grit adhere.

*N. vanhoeffeni* is only represented from a few stations and the material is sparse and rather fragmentary. In this species also the rootlets form a stalk, but no complete colony showing the attachment has been seen.

Testes of the usual type are to be seen, consisting of very numerous clusters of cells filling the proximal part of the body-cavity. Ova of moderate size are sometimes present in the same zooecia as the spermatic tissue. In the material from St. 371 (14 March 1930) many zooecia have the ovicell empty and a large egg in the body-cavity, while in others the egg has passed into the ovicell and, in some, has begun to segment. The specimen obtained by the National Antarctic Expedition in McMurdo Sound on 13 February 1902 had three ancestrulae of the same species attached to it. They are vase-shaped and have eight or nine spines and are attached by a tubular prolongation of the proximal end (Fig. 11 A). Succeeding zooecia are typical except for the absence of frontal avicularia.

4. *Notoplites vanhoeffeni* (Kluge). Fig. 10 A, B.

*Scrupocellaria vanhoeffeni* Kluge, 1914, p. 610, pl. xxvii, fig. 6.

*Notoplites vanhoeffeni* Harmer, 1923, p. 353.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, St. 190.

GEOGRAPHICAL DISTRIBUTION. Palmer Archipelago (Discovery); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition; Terra Nova).

Comparison of this species with *Notoplites drygalskii* will be found on pp. 342, 340 (key). The internal spine is stout, and may be branched almost at its base, appearing paired (Fig. 10 B).

5. *Notoplites elongatus* (Busk). Figs. 12 A, B, 13 A.

*Cellularia elongata* Busk, 1884, p. 19, pl. iii, fig. 3.

*Notoplites elongatus* Harmer, 1923, p. 351.

STATION DISTRIBUTION. *Sub-Antarctic*: South Indian Ocean, Sts. 1562, 1563.

GEOGRAPHICAL DISTRIBUTION. Kerguelen (Busk); Marion Island (Discovery; 87.12.9.97 B).

NOTOPLITES

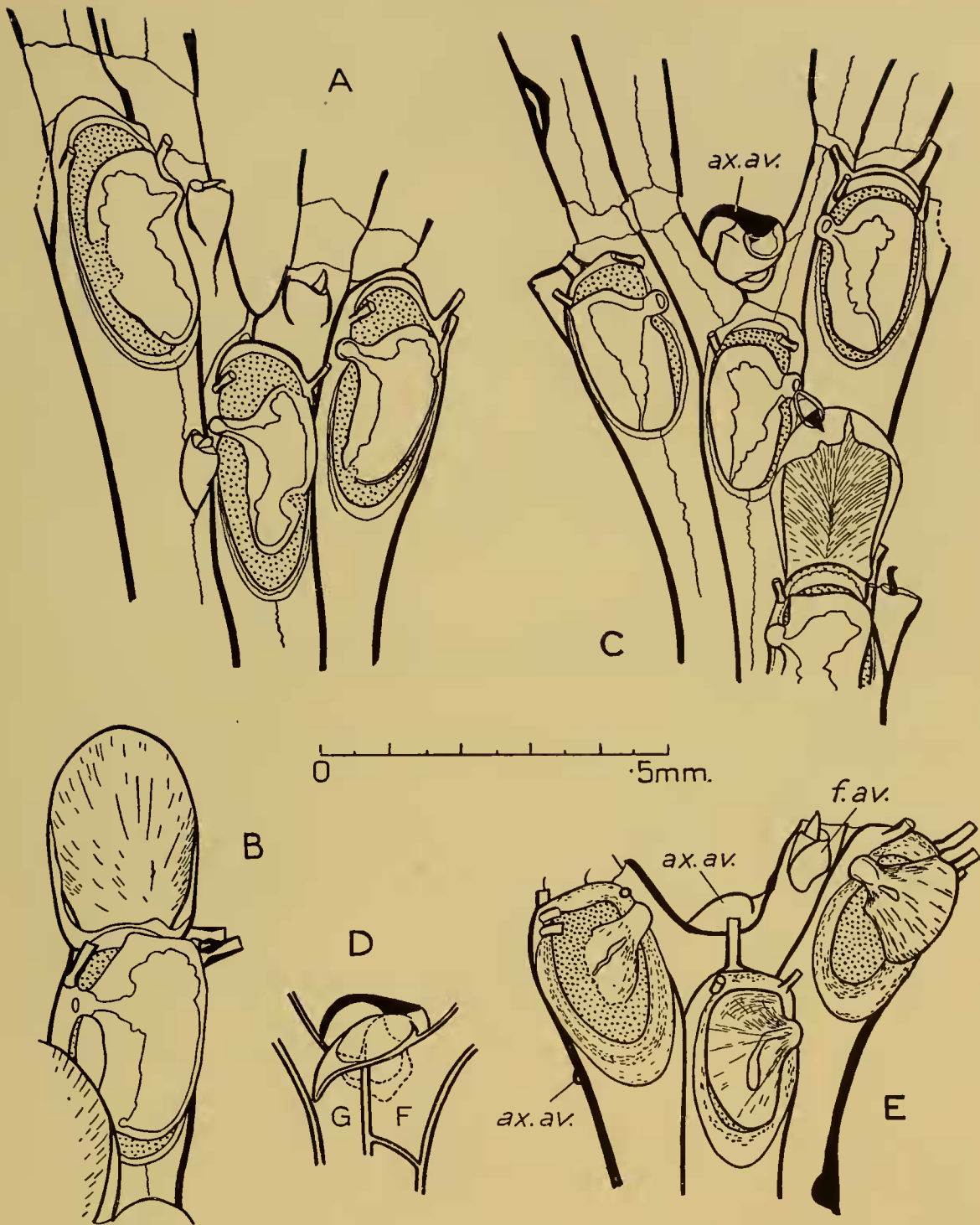


Fig. 12. A, B. *Notoplites elongatus* (Busk). A. From St. 1563, Marion Island. B. One zoecium from the type, 87.12.9.67. Challenger St. 149, Kerguelen. C, D. *N. elongatus* var. *calveti* var.n. St. WS 237, edge of Patagonian Shelf. C. Bifurcation. One marginal avicularium is broken. D. Basal view of axillary avicularium and neighbouring structures. Zoecia lettered according to Harmer's scheme. Portions of avicularium on frontal surface of branch shown by dotted lines. E. *N. crassiscutus* sp.n. St. 160, Shag Rocks. Zoecia preceding bifurcation. The tip of the axillary avicularium shows at the side of the branch.

*ax.av.* axillary avicularium, *f.av.* frontal avicularium.

The Discovery specimens from Marion Island differ from the type material from Kerguelen in the possession of frontal avicularia. These avicularia are small and are present on most of the zooecia, including one or both of the axillary zooecia (Fig. 12 A). Here they are placed proximally to the joint, with the beak turned towards the axil. In other respects the specimens agree very closely with the type. Oval areas may be present in the lateral walls (see p. 339).

A small colony of this species (87.12.9.97 B) was separated by Levinsen from the type material of *Amastigia kirkpatricki*, but left unnamed. Frontal avicularia are present on some zooecia, but not on the axillary ones.

One young colony with ancestrula (Fig. 13 A) was taken at St. 1563 (Marion Island, 7 April 1935). The ancestrula resembles that of *Notoplites tenuis* in shape. There are seven spines round the opesia and there may have been an eighth where the ancestrula is now broken. The first zooecium is connected to the ancestrula by a rather long tubular portion, and has seven spines and a small scutum. The second zooecium also has seven spines. The remaining nine zooecia have six spines each (4 : 2), but the scutum approximates to the adult form from the third zooecium onwards.

#### 6. *Notoplites elongatus* var. *calveti* var.n. Fig. 12 C, D.

*Cellularia elongata* Calvet, 1904, p. 5.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 51, WS 73, WS 79, WS 83, WS 84, WS 85, WS 88, WS 225, WS 237, WS 243, WS 244, WS 245, WS 247, WS 781, WS 794, WS 824, WS 825.

GEOGRAPHICAL DISTRIBUTION. Patagonian Shelf (Calvet; Discovery); off Patagonian Shelf down to 315 m. (Discovery).

HOLOTYPE. St. WS 237, off Patagonian Shelf.

These specimens from the Patagonian region appear to constitute a distinct variety of *Notoplites elongatus*. They differ from the type material from Kerguelen in having an axillary avicularium in many of the bifurcations. There is also a slight difference in the ovicell, the calcified part of the ectooecium being more extensive in var. *calveti* (cf. Figs. 12 B and C). In both the typical form and the variety there is a narrow smooth cryptocyst and the edge of the gymnocyst bordering the aperture may be very finely beaded, but in var. *calveti* there is coarser beading on the distal border of the aperture of the fertile zooecium, a region which is smooth in the type. The scuta are similar in shape and show curved, longitudinal lines when dry. The shape of the lumen of the scutum is variable in both, but it is usually narrower proximally in var. *calveti* than in the typical form (cf. Figs. 12 A, B and C). Var. *calveti* also differs from the type material in possessing frontal avicularia, but, as described above, these are present in specimens from Marion Island, believed to belong to the typical form. The distribution of the avicularia is, however, different. When present in the typical form they are found on nearly all the zooecia. In var. *calveti* they are rarely found except in association with ovicells (Fig. 12 C) and on the median zooecium at the bifurcation.

The axillary basal avicularium originates from the side of zooecium F (Harmer's lettering), and projects into the axil. The opesia of the avicularium is on a level with the



frontal surface of the branch (Fig. 12 C). The long, slender mandible is usually directed obliquely and is strongly arched, its articulation being on a level with the frontal surface of zoecium F, its tip lying basally to zoecium G (Fig. 12 D). In two instances the

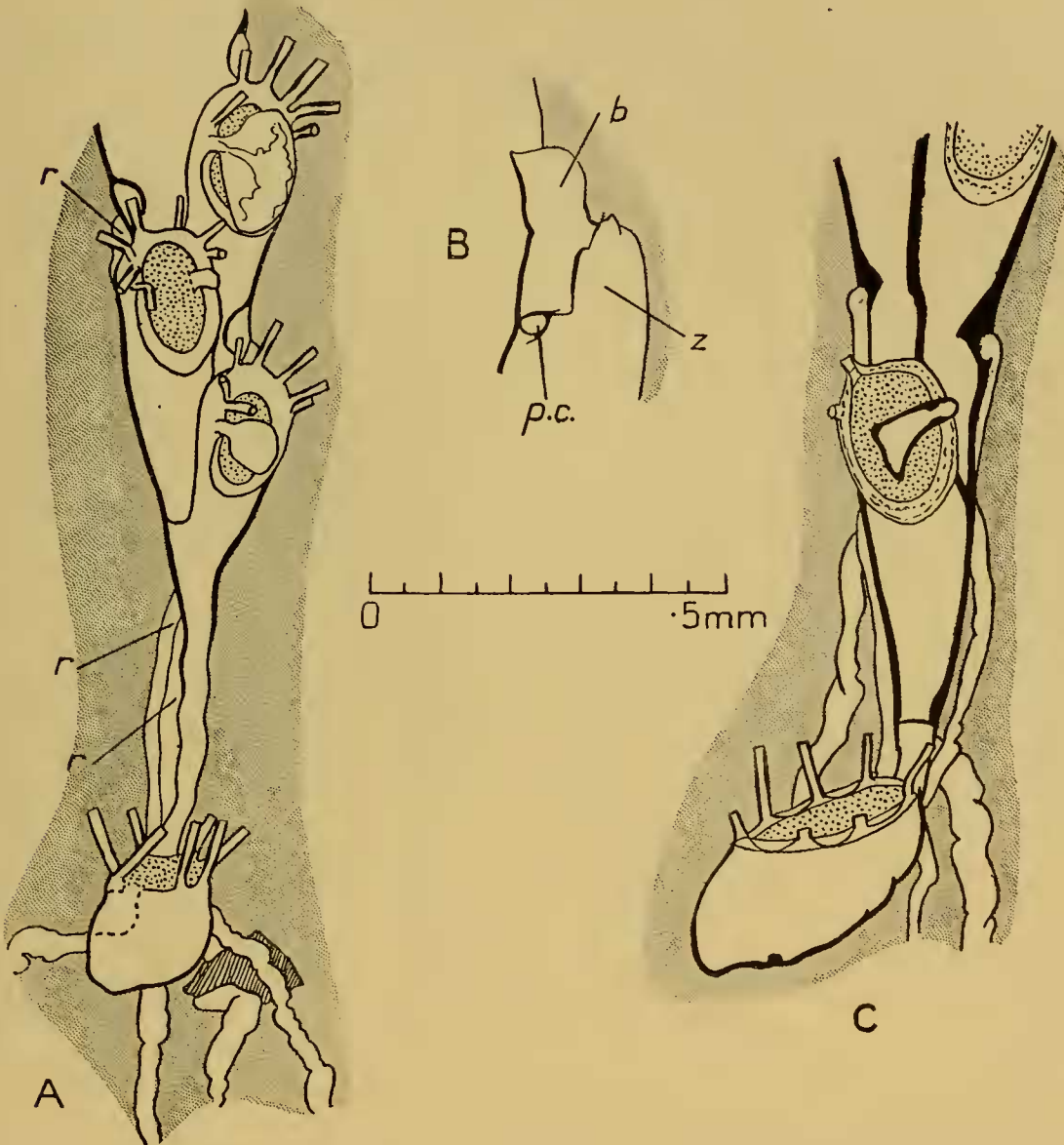


Fig. 13. A. *Notoplites elongatus* (Busk). St. 1563, Marion Island. Ancestrula and first three zoecia. The dotted line indicates a break in the ancestrula. Two of the rootlets are attached to a stone. B. *N. klugei* (Hasenbank). National Antarctic Expedition, McMurdo Sound. Bud and parts of neighbouring zoecia. C. *N. tenuis* (Kluge). St. TN 339, Ross Sea. Showing ancestrula.

*b.* bud, *p.c.* supposed pore-chamber, *r.* rootlets, *z.* proximal zoecium.

axillary avicularium was seen to be placed symmetrically in the axil with the mandible directed basally, but this position is exceptional. As Calvet mentions that his specimens from Patagonia had axillary avicularia, they presumably belong to this variety.

7. *Notoplites tenuis* (Kluge). Figs. 13 C, 15 C.

*Scrupocellaria tenuis* Kluge, 1914, p. 608, pl. xxvii, fig. 2.

*Notoplites tenuis* Harmer, 1923, p. 352.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 39, 190, 366, 371; Victoria Quadrant, Sts. 1651, 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia; South Sandwich Islands; Palmer Archipelago (Discovery); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition; Terra Nova; Discovery).

In these specimens there is considerable variation in the cryptocyst, which may, in adjacent zooecia, be distinctly granular, as figured by Kluge, or almost completely smooth. The spines, scuta and frontal avicularia are very irregularly distributed in the colony, and may be absent from many zooecia; for example, they are extremely rare in the material from St. 1652. The width of the blade of the scutum varies, so that scuta are sometimes seen which look like a flat spine turning at right angles to its base. The median zooecium at a bifurcation (E of Harmer) occasionally has two scuta, overlapping at the middle of the opesia. Basal and marginal heterozooecia have not been seen. The ovicells of a single colony may be round, as figured by Kluge, or taller and narrower. Oval areas may be present in the lateral walls of the zooecia (see p. 339 above). Testes of the usual type have been seen, consisting of very numerous clusters of cells filling the proximal part of the body-cavity.

Thirty-one<sup>1</sup> young colonies with ancestrulae have been found. The ancestrula is shallow (almost slipper-shaped) and lightly attached to the substratum by its basal surface (Figs. 13 C, 15 C). The opesia occupies the greater part of the frontal surface and is surrounded by spines. One zooecium is budded from the ancestrula. It is erect and its long axis is thus at right angles to that of the ancestrula. It is usually separated from the ancestrula by a joint. One or two zooecia (cf. Figs. 13 C and 15 C) are budded from the distal end of this first zooecium and typical biserial budding follows. A rootlet arises from each zooecium, including the first, but usually not from the ancestrula. These rootlets pass straight down the branch on to the substratum, usually leaving the ancestrula clear, but crossing it in one instance. From examination of older colonies it seems probable that the ancestrula breaks away fairly soon, leaving the colony slung by rootlets, the attachment of the ancestrula to the substratum being loose and the connexion between it and the first zooecium fragile. Occasionally the first zooecium has two to four spines, but usually it is typical, having one or none.

In the material from St. 1652 the first zooecium has in two instances given rise to a lateral zooecium as well as to the distal ones. The lateral zooecium arises at about the level of the proximal end of the opesia, and projects from the lateral wall of the zooecium at right angles. It is jointed near its proximal end, and gives rise to two distal buds. Similar lateral zooecia can also be budded from some of the subsequent zooecia. In the

<sup>1</sup> Ancestrulae were obtained as follows: two from St. 39, 25 March 1926; four from St. 366, 6 March 1930; three from St. 371, 14 March 1930; six from St. 1652, 23 January 1936; one from St. TN 339, 24 January 1912; five from St. TN 340, 25 January 1912; eight from the east end of the Barrier (National Antarctic Expedition), 29 January 1902; two from McMurdo Sound (National Antarctic Expedition), 13 February 1902.

figured specimen (Fig. 15 C) the first two zooecia have formed lateral buds. In the same material a zooecium in the more distal parts of the colony sometimes forms a single distal bud, so that, for the length of one or two zooecia, the colony is uniserial. Here too the uniserial zooecia are jointed proximally.

8. *Notoplites tenuis* var. *uniserialis* var.n. Fig. 14 A-C.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition).

HOLOTYPE. St. TN 194.

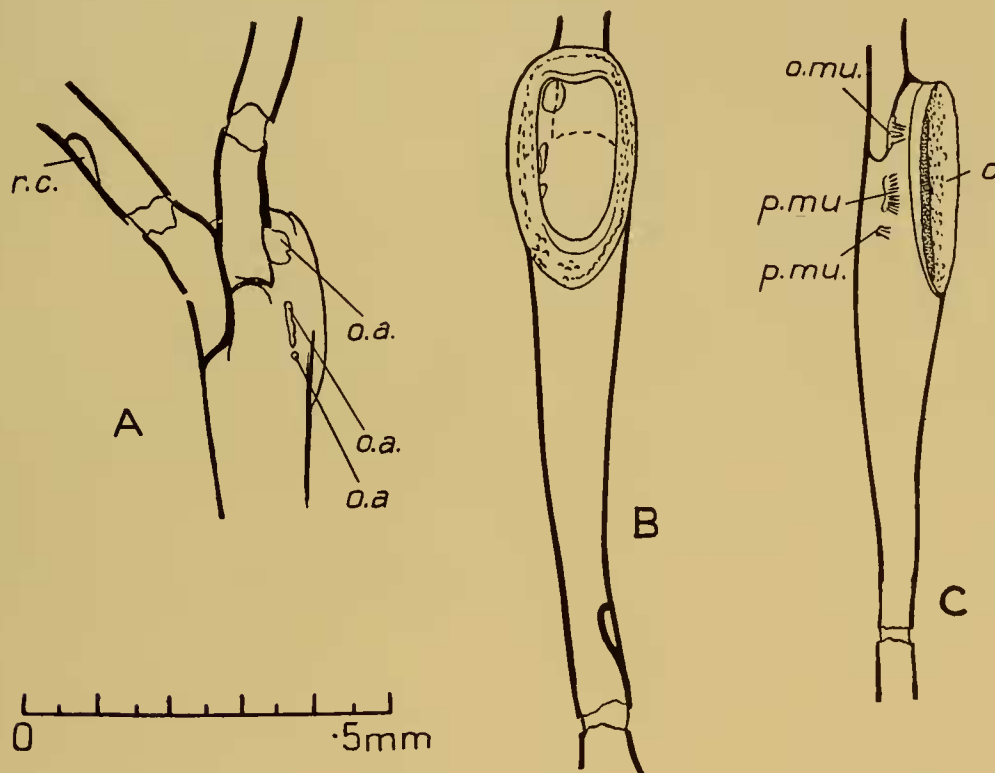


Fig. 14. A-C. *Notoplites tenuis* var. *uniserialis* var.n. St. TN 194, off Oates Land. A. Slightly oblique view of bifurcation. B. Zooecium in oblique frontal view. C. Zooecium in side view. Opesia stippled. *c.* cryptocyst, *o.a.* "oval areas", *o.mu.* occlusor muscle, *p.mu.* parietal muscle, *r.c.* rootlet-chamber.

This variety is represented by fifteen fragments, with two to twelve zooecia each. The zooecia are indistinguishable from those of *Notoplites tenuis* except that they are a little more slender (Fig. 14 B, C). Scuta and avicularia are absent (as they are on many zooecia of *N. tenuis*). As in *N. tenuis* the cryptocyst may be smooth or granular. The fragments are constantly uniserial and they bifurcate by the formation of a pair of distal buds (Fig. 14 A). Zooecia formed from lateral buds projecting at right angles to the zooecia are common. As uniserial zooecia and lateral buds have also been seen in *N. tenuis* (see p. 350) there seems to be no reason to give this form more than varietal rank. Each zooecium is jointed proximally, as in the uniserial zooecia of typical *N. tenuis*. Ovicells are unknown.

This may be *Brettia longa* Waters (1904, p. 26, pl. i, fig. 2*b*, not 2*a*; Kluge, 1914, p. 642). The "disks" described by Waters are evidently the "oval areas" (see p. 339 above) and are to be seen in these specimens, but the small frontal pores are absent and the distal spine though present in the uniserial zooecia of typical *Notoplites tenuis* is absent in the variety. The chief discrepancy is in the bifurcation. Waters's figure is difficult to interpret, but it can hardly represent the arrangement in var. *uniserialis* where the proximal segments of the daughter zooecia are in contact on the basal surface of the parent zooecium, one being slightly more proximal in origin than the other. The relation of the two daughter zooecia with the parent zooecium is, in fact, closely similar to that of zooecia F and G (Harmer's lettering) with zooecium E in the bifurcations of *N. tenuis*. The zooecia in Kluge's specimens of *Brettia longa* had a small spine at each distal corner. Lateral buds were formed. Waters's fig. 2*a* is discussed on p. 470.

9. *Notoplites klugei* (Hasenbank). Fig. 13 B.

*Menipea klugei* Hasenbank, 1932, p. 369, text-fig. 33.

*Scrupocellaria simplex* Kluge, 1914, p. 607, pl. xxvii, fig. 1.

*Notoplites simplex* Harmer, 1923, p. 353.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Bouvet Island (Hasenbank); Wilhelm II Land (Kluge); Ross Sea (National Antarctic Expedition).

This species, which is represented by one small piece, differs from *Notoplites tenuis* in its larger opesia and shorter zooecia; in the more nearly oval outline of the aperture, which in *N. tenuis* tends to have a rather straight distal border; in the absence of spines and scuta; in the occasional presence of a small marginal avicularium; and in the less complete development of joints. Kluge and Hasenbank both refer to the apparently primitive state of the joints. Kluge correctly describes the joints as being, when present, no more than breaks in the calcareous wall without special chitinous tubes, thus corresponding to the early stages in the formation of more highly developed joints. From what has been said above about the variation in the degree of granulation of the cryptocyst in *N. tenuis*, it will be seen that the smooth cryptocyst of *N. klugei* does not afford a distinguishing character. There is a small chamber projecting from the proximal wall of each zooecium. In the few zooecia mounted they are very variable in size and shape. The smallest and simplest is figured (Fig. 13 B). As far as one can tell from very scanty material these chambers are a constant feature of this species. I have not seen them in the much more abundant material of the other species of *Notoplites*, though they are described in other genera of this family by Levinsen (1916, pp. 436, 438) and Harmer (1923, p. 347), who both regarded them as pore-chambers.

The method of bifurcation, including the position of the joint when present, shows that Harmer was right in tentatively associating this species (as *Scrupocellaria simplex* Kluge) with *Notoplites*. Hasenbank transferred it to *Menipea*, and, as the name *Menipea simplex* was preoccupied by *M. simplex* nom.nud. Kirchenpauer (1889, p. 288), he introduced the name *M. klugei* for Kluge's species. According to Article 36 of the

International Rules of Nomenclature a name once suppressed as a homonym cannot be used again. The rule presumably applies here, and I therefore retain Hasenbank's specific name.

10. *Notoplites crassiscutus* sp.n. Figs. 12 E, 15 A, B, 16 A, B.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant. Sts. 42, 160.

GEOGRAPHICAL DISTRIBUTION. South Georgia; Shag Rocks (Discovery).

HOLOTYPE. St. 160, Shag Rocks.

DESCRIPTION. *Zoarium* of the type characteristic of the genus, biserial (Fig. 15 A). *Zooecia* slender, with oval opesia and wide, more or less granular, cryptocyst (Fig. 15 A, B).

*Spines*, three external, one internal.

*Scutum* large and stout, proximal lobe usually the larger, lumen small, linear or with a proximal arm at right angles, outer surface with striations radiating from stalk.

*Frontal avicularia* small, often present on median zooecium (E), at bifurcation, sometimes on axillary zooecium (F or G), placed on portion proximal to joint (Fig. 12 E), occasionally on other zooecia.

*Marginal avicularia* absent.

*Basal avicularia* (Figs. 12 E, 15 A, 16 A) at each bifurcation originating from zooecium F (Harmer's lettering) with very long slender mandible directed from axil along basal surface of branch in obliquely proximal, occasionally almost transverse, direction.

*Ovicells* unknown.

REMARKS. In the specimen from St. 42 the lumen of the scutum tends to be more extensive and the striations are less conspicuous than in the type, but there is a good deal of variation, some scuta having lumina like those of the type specimen. In both specimens there is considerable variation in the degree of granulation of the cryptocyst. The figured zooecia show the maximum and minimum.

*Notoplites crassiscutus* appears to be more nearly related to *N. elongatus* (Busk) than to other species. It differs from *N. elongatus* in the absence of marginal avicularia, in its granular cryptocyst, and in its scutum, which is similar in shape, but has its lumen greatly reduced and its frontal surface convex and radially striated. Like *N. elongatus* var. *calveti*, *N. crassiscutus* has an axillary avicularium, with long slender mandible, originating from zooecium F. In var. *calveti* the mandibular surface of this avicularium is strongly convex, the opesia facing towards the frontal surface of the colony and the mandible arching round so that its distal part lies along the basal surface of the branch (Fig. 12 C, D); but in *N. crassiscutus* the mandible and opesia of the avicularium are not visible in a frontal view, the mandibular surface being relatively flat and entirely on the basal surface of the branch (Fig. 16 A), part of the chamber alone being visible in a frontal view of the branch (Figs. 12 E, 15 A). Although the avicularium is larger, a much smaller part of it is actually in the axil in *N. crassiscutus* than in var. *calveti*. The mandible in *N. crassiscutus* is longer and may project beyond the margin of the branch.

*N. tenuis* differs from *N. crassiscutus* in having longer zooecia of more uniform width;

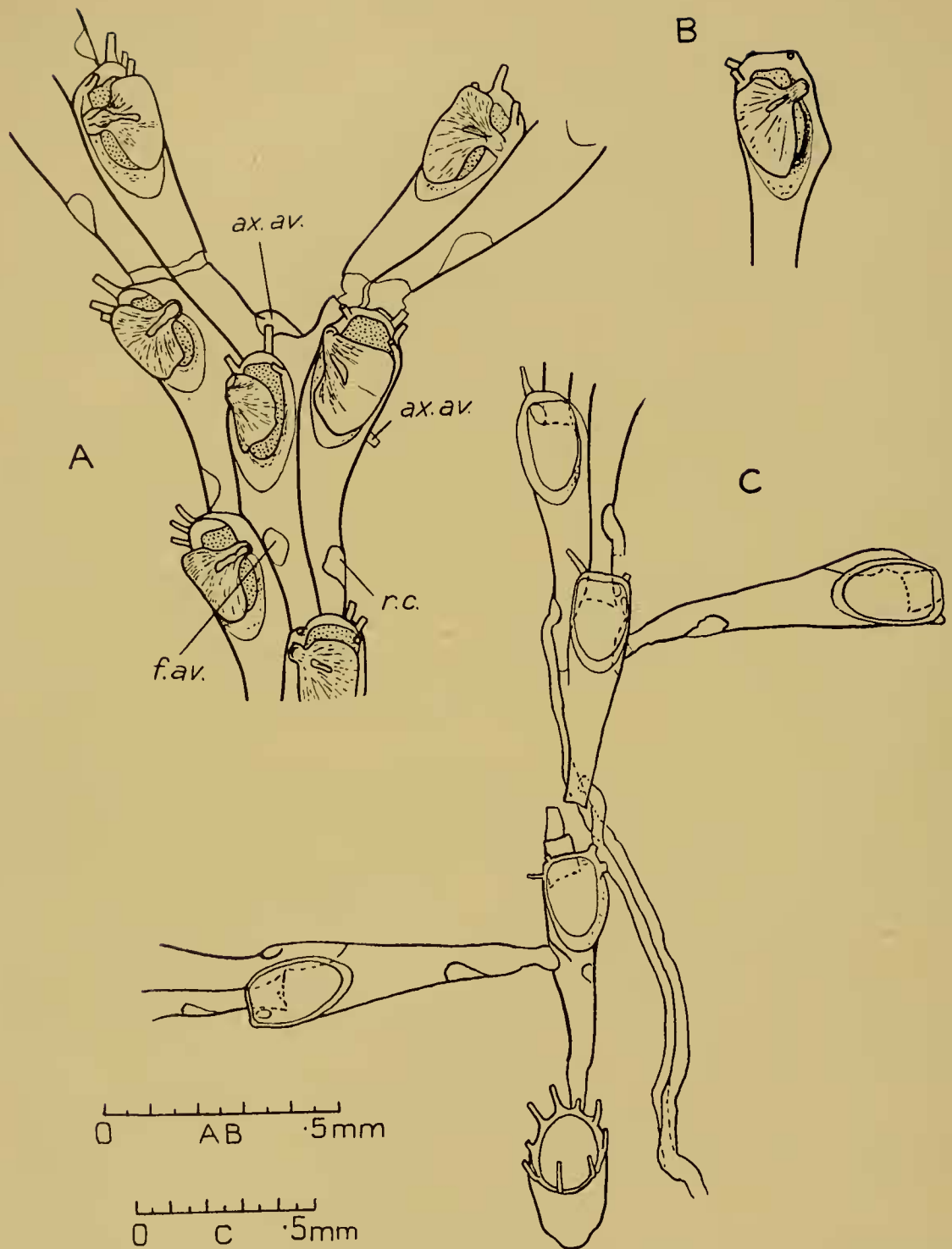


Fig. 15. A, B. *Notoplites crassiscutus* sp.n. St. 160, Shag Rocks. A. Frontal view. B. Zoecium with more granular cryptocyst than those in A. C. *N. tenuis* (Kluge). St. 1652, Ross Sea. Showing ancestrula and lateral branches.

*ax.av.* axillary avicularium whose tip projects at the side of the branch, *f.av.* frontal avicularium (incomplete), *r.c.* rootlet-chamber.

in its less numerous spines and in the raised border to the aperture; in the shape of the scuta and in the absence of axillary avicularia.

All three species agree in the possession of areas (Fig. 16 B) in the lateral walls corresponding to the muscle attachments (see p. 339).

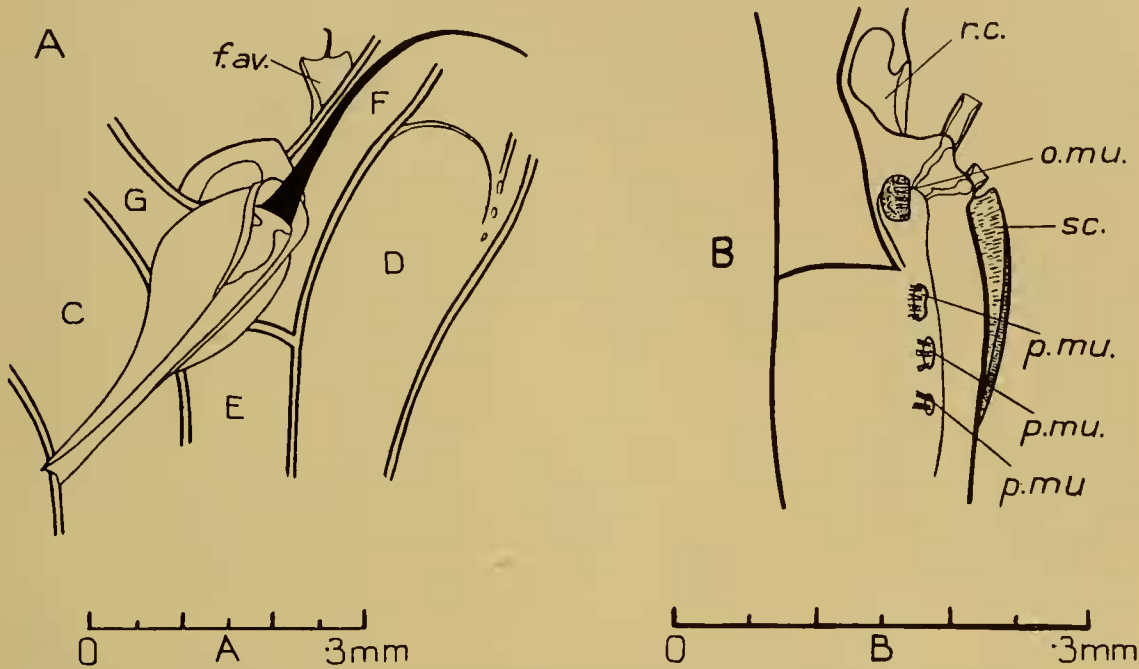


Fig. 16. A, B. *Notoplites crassiscutus* sp.n. St. 160, Shag Rocks. A. Basal view of axillary avicularium. Underlying zooecia outlined, and lettered according to Harmer's scheme. B. Oblique basal view of parts of two zooecia.

*f.av.* frontal avicularium of zooecium F, *o.mu.* occlusor muscle, *p.mu.* parietal muscles, *r.c.* rootlet-chamber in thickness of wall, *sc.* scutum.

## 11. *Notoplites perditus* (Kluge).

*Scrupocellaria perditia* Kluge, 1914, p. 613, text-fig. 2.

*Notoplites? perditus* Harmer, 1923, p. 353.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Southern Ocean, 2450 m. (Kluge).

*Notoplites perditus*, which I have not seen, has quite conspicuous marginal avicularia and a small uncalcified area in the ectooecium, thus resembling the members of the *N. antarcticus* group (see Key p. 340, bifurcation 2). Kluge does not mention internal spines, but as he mentions them in only one of the four members of the group, and as he described *N. perditus* from a small fragment which was lost after only a preliminary examination, they may yet prove to be present. Frontal avicularia appear to have been absent, and the rounded scutum with a small, sharply demarcated, distal lobe would, if constant, be characteristic.

## Tricellaria Fleming, 1828

1. *Tricellaria monotrypa* (Busk). Fig. 17 A.

*Cellularia monotrypa* Busk, 1852a, p. 368.

*Cellularia cuspidata* Busk, 1852b, p. 19, pl. xxvii, fig. 12.

*Tricellaria monotrypa* Harmer, 1923, p. 355.

*Bugulopsis cuspidata* Stach, 1937, p. 378.

STATION DISTRIBUTION. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Busk; Terra Nova; Discovery); Bass Strait (Busk; Livingstone).

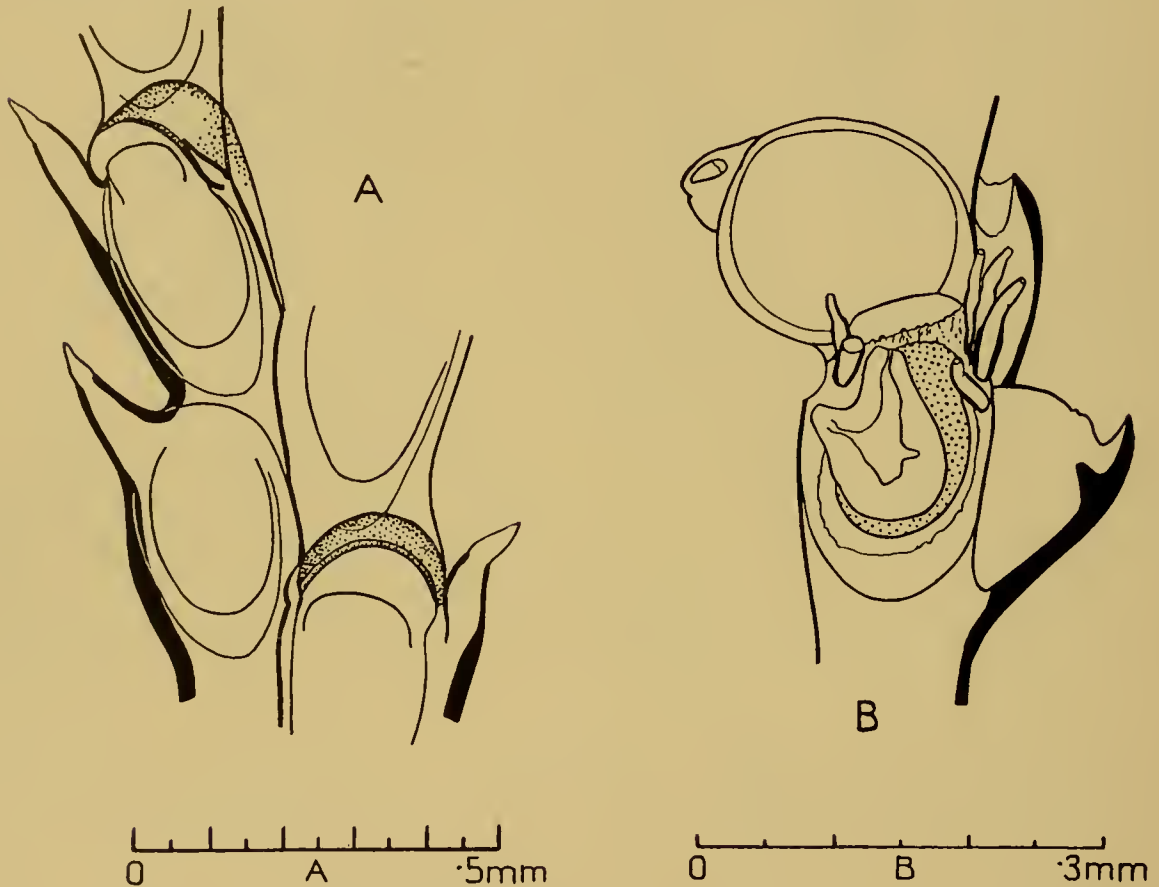


Fig. 17. A. *Tricellaria monotrypa* (Busk). St. 934, New Zealand. Fertile and non-fertile zoecia. B. *Scrupocellaria ornithorhyncus* (Thom.). 97.5.1.219. Port Phillip Heads. To show tuberculation of distal border of aperture of fertile zoecium. Curious shapes of spines may be due to regeneration.

The ovicell (Fig. 17 A) was observed and described by Busk (1852a). It is shallow and endozooecial, incapable of accommodating the whole embryo. The fertile zoecium bears a little spike-like spine on the inner distal corner, curved towards the ovicell.

2. *Tricellaria aculeata* (d'Orbigny).

*Bicellaria aculeata* d'Orbigny, 1847, p. 8.

*Tricellaria aculeata* d'Orbigny, 1842, pl. ii, figs. 1-4; Harmer, 1923, p. 355; Monod and Dollfus, 1932, p. 61.



*Menipea fuegensis* Busk, 1852*b*, p. 21, pls. xix, figs. 1-3; Jullien, 1888, p. 70, pl. vii, figs. 8-10, pl. xii, figs. 1, 2; Calvet, 1904, p. 6; Vallentin, 1924, p. 373; Hasenbank, 1932, p. 365.

*Menipea aculeata* Busk, 1884, p. 20, pl. iv, fig. 2; Calvet, 1904, p. 6; Marcus, 1921*b*, p. 93; Vallentin, 1924, p. 373.

*Scrupocellaria fuegensis* Waters, 1904, p. 24.

*Scrupocellaria bifurcata* Kluge, 1914, p. 614, text-fig. 3.

*Menipea patagonica* (part) Busk, 1852*b*, pl. xxiii, fig. 1.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 51, 53, 652, 1230, 1902, WS 72, WS 79, WS 84, WS 85, WS 87, WS 88, WS 95, WS 220, WS 222, WS 244, WS 245, WS 838, WS 847, WS 871.

GEOGRAPHICAL DISTRIBUTION. Chile (Busk); Magellanic Region (Busk; Jullien; Waters; Calvet; Hamburg Museum, B. 1205; Discovery); Patagonian Shelf (d'Orbigny; Busk; Calvet; Vallentin; Discovery); off Patagonian Shelf down to 339 m. (Discovery); Kerguelen (Busk; Kluge; Hasenbank; Monod and Dollfus); South Georgia (Calvet); Bouvet Island (Hasenbank); Campbell Island (Marcus); Auckland Island (National Antarctic Expedition); New Zealand (Hamilton; 97.5.1.265; 99.7.1.734).

The synonymy of this species has been discussed by Waters, Marcus and Harmer. Waters considered that he had no proof that there were not three distinct species. Marcus accepted *Tricellaria aculeata* (Busk) as the form intended by d'Orbigny and thought that *T. fuegensis* (Busk) was probably the same thing, but was not satisfied about *T. fuegensis* (Jullien). Harmer regarded them all as representing a single variable species, and after examining the Discovery collection and the specimens in the Busk and other collections in the British Museum I agree with him.

In the one small colony from Challenger St. 314 zooecia can be seen in which the scutum is simple and unbranched, bears two, three or four points, or is completely absent; the lateral avicularium may be present or absent and varies in size; the frontal avicularium is occasionally absent and the distal spines may be stout or slender, long or short, varying in number from two to four. The zooecia are more delicate and slender than in the specimen described by Busk in 1852, but other specimens are more or less intermediate. I therefore regard *T. aculeata* (Busk) and *T. fuegensis* (Busk) as synonymous. Marcus was doubtful whether there might not be a difference in the cryptocyst of these two forms, but I have not detected any.

Apart from features that have already been shown to be variable, such as the scutum and spines and the presence or absence of frontal avicularia, the chief feature mentioned by Waters as distinguishing *T. fuegensis* (Jullien) from *T. fuegensis* (Busk) is the large number of zooecia in the fertile internodes of the former (3-14 in the figure). Ovicells are completely absent from Busk's type-specimen but were on short internodes in Waters's own specimen which agreed with *T. fuegensis* Busk in other respects. In the present material the number of the zooecia in the fertile internodes varies from three to fifteen. Those colonies with the longest internodes (namely, those from St. 53, in which the full range from three to fifteen is found, and some from the Falkland Islands, 24.9.1.1, with a maximum internode of ten zooecia) have certain features in common with Jullien's figure. The non-fertile internodes consist of relatively long, stout zooecia,

and are less tapering proximally and less sinuous in outline than those of colonies with shorter fertile internodes. Most of the zooecia have no frontal avicularia, and the lateral avicularia, which are not present on all the zooecia, have their palatal surface tilted obliquely towards the frontal surface of the colony. The scutum is usually unbranched and not much curved over the opesia, commonly having the appearance of an extra spine rather than a typical scutum. Other specimens are, however, more or less intermediate between *T. fuegensis* (Busk) and *T. fuegensis* (Jull.). For example, some fragments from St. WS 85, with as many as nine zooecia in a fertile internode, have slender zooecia, branched scuta, lateral avicularia not tilted and often absent, frontal avicularia commonly present; and in Kluge's figure of a specimen from Kerguelen (described as *Scrupocellaria bifurcata*), also with nine zooecia in the fertile internode, some of the avicularia appear to have the oblique palatal surface, and the non-fertile internode is straight and fairly stout, but frontal avicularia are present, and the scuta are well developed and curved over the opesia.

Kluge regarded his *S. bifurcata* as differing from *Tricellaria aculeata* (Busk) chiefly in the presence of a marginal avicularium, which he recognized as a variable character, and in the presence of four distal spines on most zooecia, but some specimens from the Falkland Islands may have four spines on most of the zooecia (Valentin Coll. 35.3.6.298 and 377), and the majority of South American specimens have four on some zooecia. Material from Kerguelen in the British Museum shows similar variation; that of Busk 1879 has four spines on some zooecia and four are commonly present on the zooecia of specimens found among unnamed material from Challenger St. 149 (34.11.12.78). Hasenbank's specimens from Bouvet Island are described with four to six spines. All this strongly supports Harmer's conclusion that *Scrupocellaria bifurcata* Kluge is a synonym of *Tricellaria aculeata*.

Considering the irregularity of the distribution of avicularia and scuta and the variability in their size, the less powerful optical instruments of a century ago, and the fact that d'Orbigny's specimens come from the same region as those since described, a region from which no specimens agreeing more exactly with his figures are known, I agree with Harmer and Marcus that one should accept d'Orbigny's name for this species.

All the material from New Zealand that I have examined has short rather strongly calcified zooecia with usually four or five spines on the distal zoecium of the internode.

Canu and Bassler (1929, p. 224) put this species into a new genus *Monartron* with *Menipea* [*Emma*] *cyathus* Thomson as genotype. *M. cyathus* differs from the other species of *Emma*, as understood by Harmer (1923), in its hyperstomial ovicell, slight cryptocyst and uniserial joints, and one can quite well argue that it should be separated from *Emma*, but, except for the one character of the uniserial joints, *Tricellaria aculeata* resembles *T. ternata* (genotype of *Tricellaria*) more closely than it does *Menipea cyathus*. Whatever views one may hold about the position of *M. cyathus* there is clearly no justification for separating *Tricellaria aculeata* from *T. ternata* in order to associate it with *Menipea cyathus*.

Busk's figure (1852*b*, pl. xxiii, fig. 1), supposed to represent the ancestrula and first few zooecia of *M. patagonica*, agrees so closely with the type-specimen of *Tricellaria*

*fuegensis* (54.11.15.262) that it must have been drawn from it. The basal parts of the colony differ from the corresponding parts of true *Menipea patagonica* (Fig. 6 A) in the shape of the ancestrula; in the smaller number of zooecia in the first two internodes; in the more or less frontal origin of the rootlets; and in the presence of scuta, of which the bases now remain. In the specimen figured by Busk the first internode consists of one zooecium. In the Discovery material from St. WS 84 (24 March 1927), and specimens belonging to the Hamburg Museum (B. 1025) and the U.S. National Museum, there are three zooecia in the first internode. The ancestrula figured by Jullien (1888, pl. vii, fig. 8) is a little taller than those examined by me.

### 3. *Tricellaria* sp.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Challenger St. 299, off Valparaiso, 3953 m. (99.7.1.4564).

DESCRIPTION. *Zoarium* biserial, bifurcation of Harmer's type 9 with one branch (the one including zooecia CG) at each bifurcation unjointed.

*Zooecia* raised distally, opesia more or less oval with thin raised edge, tubular proximal portion forming more than half and often more than two-thirds of length of zooecium, frequently with faint transverse striations.

*Spines*: 2 to 4 long curved spines arranged in an oblique row running from outer distal corner across basal surface of projecting distal end of zooecium; frequently a stout straight spine on raised edge of inner border of opesia towards proximal end, directed frontally.

*Scutum* absent.

*Rootlets* springing laterally from portion of zooecium C proximal to joint and from proximal part of some other zooecia; not applied to surface of colony.

*Avicularia* and *ovicells* not seen.

REMARKS. The single small specimen of this species was found in the Busk Collection, labelled *Bicellaria*. It was only discovered after some of the books and specimens necessary for its proper comparison with known species had been stored for safety during the war. It is, however, certainly distinct from seven of the eight species included in *Tricellaria* by Harmer (1923, p. 354). The description of the eighth species, *T. pribilofi*, is not available. It is probably also distinct from Harmer's two additional species (1926, pp. 356, 358).

In its bifurcation, with one branch unjointed, *Tricellaria* sp. resembles *T. sympodia* (Yanagi and Okada, 1918, p. 410, Japan 457.5 m.), and *T. aquilina* and *T. scalariformis* Harmer (1926, Malay Archipelago 2081 m. and 270-469 m. respectively).<sup>1</sup> It differs from all three in the absence of avicularia, in its free rootlets and in the number and arrangement of its spines. It appears to be most nearly related to *T. aquilina* which it resembles in the separation of the bases of zooecia F and G on the basal surface of E. The long spines on the inner margin of the opesia may be on zooecium A or B, or (in one instance) on one of the zooecia on the undivided sympodial branch. They are

<sup>1</sup> See Addendum, p. 501.

placed more proximally and directed more frontally than in *T. aquilina*. The opesia is usually a little shorter than in *T. aquilina*.

Emma Gray, 1843

1. *Emma triangula* Hastings.

*Emma triangula* Hastings, 1939, p. 323, text-fig. 272 A.

STATION DISTRIBUTION. *New Zealand*: Sts. 934, 935.

GEOGRAPHICAL DISTRIBUTION. Australia; New Zealand (Hastings).

Scrupocellaria Van Beneden, 1845

1. *Scrupocellaria ornithorhyncus* Thomson. Fig. 17 B.

*Scrupocellaria ornithorhyncus* Thomson, 1858, p. 144.

*Scrupocellaria ornithorhynchus* Busk, 1884, p. 24, pl. xi, fig. 6; MacGillivray, 1886*b*, p. 102, pl. cxxvi, figs. 9, 9 *a-c*; 1887*b*, p. 200; Livingstone, 1929, p. 53.

*Scrupocellaria pilosa* Busk, 1884, p. 24, pl. xi, fig. 7.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 4, 5, 339, 1321. *New Zealand*: St. 934. *Victoria*: St. 1686.

GEOGRAPHICAL DISTRIBUTION. Victoria (Thomson; MacGillivray; Discovery); Tasmania (50.1.21.19); Sandwich Islands (Busk<sup>1</sup>); New Zealand (Livingstone; Discovery); Island of South Trinidad, off Brazil (Terra Nova); John Adams Bank, off Brazil (1937.10.14.1); Tristan da Cunha (Busk; Discovery); Gough Island; Magellanic Region (Discovery).

The Discovery specimens from Tristan agree exactly with those from the same group of islands wrongly determined by Busk (1884, p. 24) as *Scrupocellaria pilosa* Aud. (see Harmer, 1926, p. 383). The species from Tristan agrees very closely with Australian specimens believed to belong to *S. ornithorhyncus* Thomson. In both, the distal border of the aperture is tuberculate in fertile zooecia (Fig. 17 B); the full complement of spines appears to be four outer and two inner; and some of the marginal avicularia are large, and have a stout, sharp-pointed end to the beak, as figured by both Busk and MacGillivray. MacGillivray described *S. ornithorhyncus* as having a bifurcate or double spine close to the base of the scutum, but he was probably misled by the very close approximation of the two inner spines. With one exception the spines in his figure accord with this interpretation.

Busk described the Tristan species as slender, and *S. ornithorhyncus* as very slender, though his figures (1884, pl. xi, figs. 6*a*, 7*a*) depict *S. ornithorhyncus* as the stouter of the two. In reality there is no appreciable difference in this respect between his specimens. There is some variation in the stoutness of the branches in the British Museum material as a whole, but this appears not to be correlated with distribution. Thomson described the cryptocyst of *S. ornithorhyncus* as granular ("tuberculated crescentic plate"), but Busk described both forms as having smooth cryptocysts. In reality both are variable; a few distinct granulations are sometimes to be seen in specimens from Tristan, and in Australian material zooecia with quite smooth cryptocysts can be found.

<sup>1</sup> A specimen in the Busk Collection, collected by the 'Challenger' at the Sandwich Islands, and labelled *S. ornithorhynchus*, proved to be wrongly identified (see Harmer, 1926, p. 370), but true *S. ornithorhyncus* was also obtained from that locality by the 'Challenger' (87.12.9.108).

In the material from the Magellan region the marginal avicularia are all of the same, rather small, size, and in the New Zealand specimen the larger ones are not so large as usual. Both these specimens have the cryptocyst smooth, and are rather slender. Ovicells are not present.

*S. ornithorhyncus* is distinguished from British specimens of *S. scrupea* by several small but definite differences. The marginal avicularia are farther from the distal end of the zooecium in *S. ornithorhyncus*, often being entirely proximal to the spines and always extending as far back as the proximal end of the opesia, or farther. The fertile zooecia of *S. scrupea* have a smooth distal wall. Other differences are less definite. *S. scrupea* has as a rule stouter branches, with less markedly serrated borders (because of the smaller marginal avicularia), and more zooecia in the internodes. Its scutum is blunter distally and I have seen no specimen with more than three outer spines. In both species the joint may just touch the proximal border of the opesia of the outer zooecium, but in *S. scrupea* it sometimes passes through the proximal part of the opesia, whereas in *S. ornithorhyncus* it is commonly in the proximal gymnocyst at a distance from the opesia.

The supposed Australian specimens of *S. scrupea* in the British Museum, including those in the Bracebridge Wilson collection (97.5.1.219, 220) which probably represent the form called *S. scrupea* by MacGillivray, belong to *S. ornithorhyncus*, and it seems possible that some other published records of *S. scrupea* may be based on this species. For example, *S. scrupea* Marcus (1937, p. 56; 1938b, p. 208), from Brazil and St Helena, may be *S. ornithorhyncus*. Both specimens had four outer spines and the figure (1937, pl. xi, fig. 27 A) shows most of the marginal avicularia in the more proximal position. On the other hand, the character of the distal wall of the fertile zooecium does not appear, and the branch is as stout as those of *S. scrupea*. No evidence is available about the specific characters of *S. scrupea* Stach (1937, p. 379). Harmer (1926, p. 382) has shown that *S. scrupea* Philipps is a synonym of *S. spatulata* (d'Orbigny).

## 2. *Scrupocellaria frondis* Kirkpatrick. Fig. 18 A-D.

*Scrupocellaria frondis* Kirkpatrick, 1890, p. 504, text-fig. 1.

not *Scrupocellaria frondis* Thornely, 1912, p. 140.

STATION DISTRIBUTION. *Ascension Island*: St. 1.

GEOGRAPHICAL DISTRIBUTION. Fernando Noronha; Pernambuco (Kirkpatrick); Ascension Island (Discovery); Tortugas (31.12.9.7).

This species, originally described from a few fragments, may usefully be redescribed here.

DESCRIPTION. *Zoarium* branches rather straight and not widely divergent.

*Zooecia* (Fig. 18 B) smaller than those of *Scrupocellaria bertholletii*. Opesia oval, occupying about one-half length of zooecium, filled by scutum, no cryptocyst. Lumen of scutum usually constricted or closed at a point near stalk, with three or four recurved, undivided branches on each side. Spines three external, two internal, and, on non-fertile zooecia, one distal. Proximal external spine curved across aperture, cervicorn

in most zooecia, with two to five tines, and crossing proximal internal spine which is stout, unbranched, and curved across aperture.

*Frontal avicularia* small, absent from many zooecia, slightly larger on median zooecium at bifurcation.

*Lateral avicularia* absent.

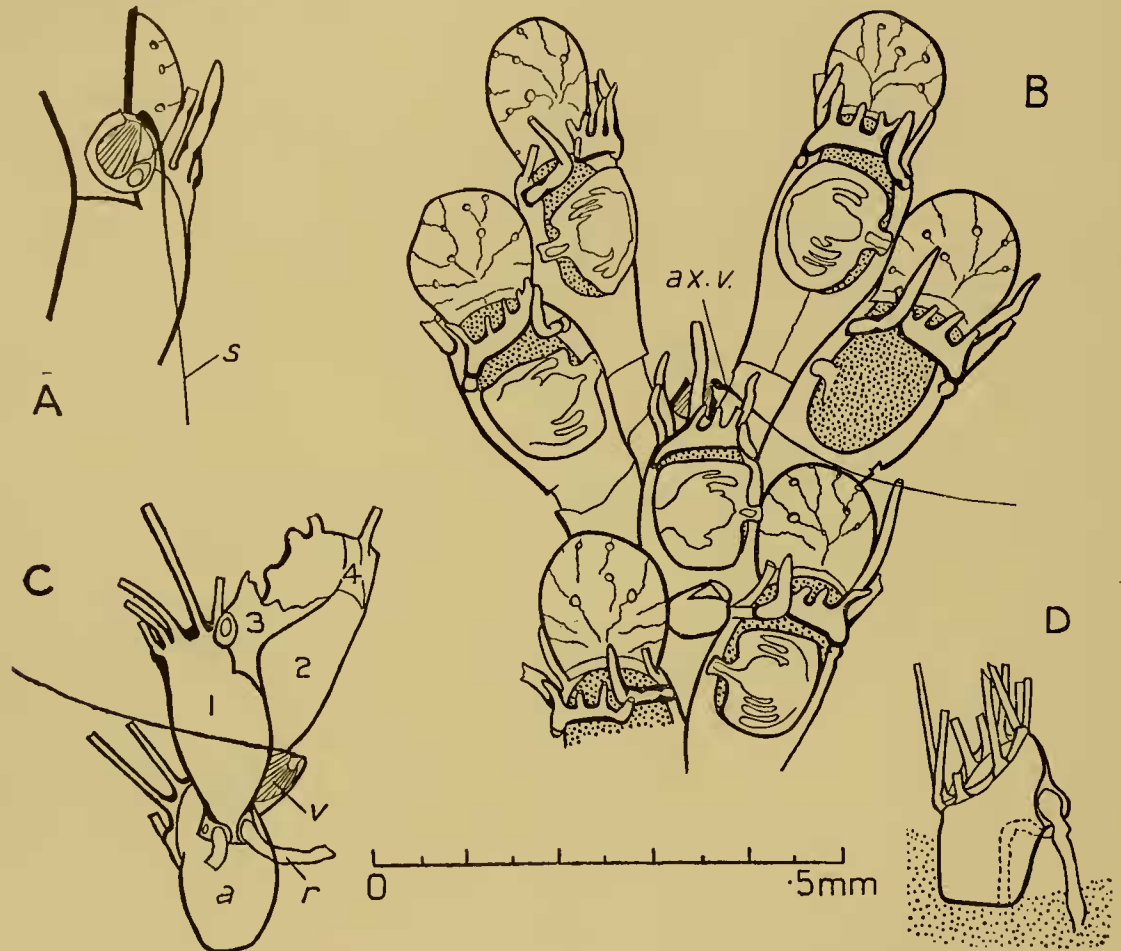


Fig. 18. A-D. *Scrupocellaria frondis* Kirkpatrick. A. 31.12.9.7. Dry Tortugas. Basal view showing vibraculum and adjacent structures. B. 31.12.9.7. Dry Tortugas. Frontal view. C. St. 1, Ascension Island. Young colony in slightly oblique basal view. D. 31.12.9.7c. Dry Tortugas. Ancestrula with rootlets and rudiments of first zooecium. Polypide omitted.

*a.* ancestrula, *ax.v.* axillary vibraculum, *r.* rootlet, *s.* seta, *v.* vibraculum, 1-4, first four zooecia.

*Vibracula* (Fig. 18 A). Vibracular chamber not visible in frontal view of branch, longer than wide, with lateral rootlet chamber, whole structure nearly circular, truncated distally by transverse vibracular groove. Seta long and fine. One small vibraculum in axil of bifurcation.

*Ovicells* longer than wide, with a few pores connected by radiating sutures.

*Rootlets* smooth.

REMARKS. The Discovery specimens agree very closely with the type and with the specimens from the Tortugas figured here. The branches of the lumen of the scutum are sometimes not quite so much recurved.

In the specimen from Pernambuco some zooecia agree very closely with the type, but in others the branched spine has fewer tines and is less curved.

Several species with similar scuta are known from the tropical region of the Atlantic. Smitt (1872, pp. 13, 14) described three from Florida as *S. cervicornis* (Pourt.),<sup>1</sup> *S. cornigera* (Smitt) and *S. pusilla* (Smitt), and Waters described *S. tridentata* from the Cape Verde Islands. Professor R. C. Osburn has found Smitt's three species at the Tortugas, and has very kindly sent me specimens of *S. cervicornis* (35.11.26.3) and *S. cornigera* (35.11.26.2) and examined part of my material. *S. pusilla*<sup>2</sup> is represented in the British Museum by some fragments from John Adams Bank, off Brazil (99.7.1.786, 787). Smitt's figures are accurate in all matters of importance, and there can be no doubt that *S. frondis* is distinct from all three species. The bifid spine is a variable feature and I have seen it in both *S. cervicornis* and *S. cornigera* (cf. Marcus, 1937, pl. xi, fig. 26 A). *S. frondis* differs from both these species in the presence of the large cervicorn spine, in the rounded scutum which never has the sharply pointed corners, in the absence of lateral avicularia, and in the shape of the vibracula. The vibracular chambers of *S. cervicornis* not only differ in shape, but are conspicuous in frontal view. *S. pusilla* is a smaller, more delicate species. Its scutum is similar to that of *S. frondis*, but it has no cervicorn spines, its vibracula are very different in shape, it has lateral avicularia and its branches are more sinuous in outline.

Professor Osburn tells me (in a letter, 1935) that his *S. cervicornis* (1914, p. 192) is the true *S. cervicornis* Smitt, that its "cervicorn" spines would have been better described as bifid, and that he has not before seen the species with the truly cervicorn spine.

*S. cervicornis* Verrill (1900, p. 593) from Bermuda may have been one of these species, but in the absence of any mention of branched spines is probably not *S. frondis*.

*S. tridentata* Waters possesses lateral avicularia, and enlarged trifurcate frontal avicularia below the bifurcation, and has the spines arranged differently and all unbranched.

The vibraculum of *S. frondis* resembles that of *S. bertholletii* (Audouin), a species whose rather larger zooecia have the same number of spines, but all unbranched, and similar ovicells. The scuta of the two species are markedly different. The absence of lateral avicularia is a distinction from specimens of *S. bertholletii* so far described, but colonies from the Tortugas (Colman-Tandy Coll. 31.12.19.4; Professor Osburn, 35.11.26.1), and from Mozambique (1938.5.2.4), which otherwise agree exactly with that species, have none.

Thornely has noted that the form recorded by her as *S. frondis* differs from Kirkpatrick's species in the presence of marginal avicularia and the shape of the scutum. These points are confirmed by examination of her specimen in the British Museum (1936.12.30.173), but I have been unable to see any "tree-like" markings on the

<sup>1</sup> Not *S. cervicornis* Busk 1852a = *S. diadema* (see Harmer, 1926, p. 375).

<sup>2</sup> Harmer (1926, p. 382) regarded *S. pusilla* as synonymous with *S. spatulata* (d'Orbigny), but as my remarks are based entirely on specimens from the Western Atlantic, the locality studied by Smitt, I have used the name *S. pusilla* in this discussion.

scuta, which appear to have a rather narrow, unbranched lucida, running straight from the stalk to the opposite border of the blade, i.e. down the middle of the long axis of the scutum and transverse to the long axis of the zooecium. The zooecia are a little shorter and stouter than those of *S. frondis* and the ovicells are also shorter in proportion to their width and have more numerous pores with raised borders. The frontal avicularia are raised on short columns, those of *S. frondis* being sessile, and the cervicorn spine also differs. In Thornely's specimen its main axis is broad and flattened and the tines are more numerous and shorter than in true *S. frondis*. Finally the vibracular chambers are much larger than those of *S. frondis*, though similar in shape. I therefore regard Thornely's specimen as representing a distinct species.

The Tortugas material of *S. frondis* consists of a number of colonies growing together on weed. In most of them the ancestrula, which is evidently joined to the first zooecium by a very fragile connexion, has broken away, but one was found complete (Fig. 18 C), and another ancestrula which had not yet formed a whole daughter-zooecium was growing on the same weed and evidently also belonged to this species (Fig. 18 D). From Ascension Island (St. 1, 16 November 1925) there are two similar ancestrulae, each with two daughter zooecia and the beginning of a third. The ancestrulae are short, with straight or convex sides and an oblique terminal opesia. They have ten spines surrounding the opesia and no scutum. They are slung by two rootlets, one issuing from each proximal corner of the first zooecium, and the second zooecium has a vibraculum which gives rise to another anchoring rootlet. All the zooecia have scuta and the typical number of spines. The number of tines on the branched spine, which is bifid in the first zooecium, gradually increases, and both the proximal spines gradually become more curved over the aperture. The typical arrangement is attained by the end of the second or beginning of the third internode.

#### Canda Lamouroux, 1816

##### I. *Canda arachnoides* Lamouroux.

*Canda arachnoides* Lamouroux, 1816, p. 132; 1821, p. 5, pl. lxiv, figs. 19-22; Busk, 1852*b*, p. 26, pl. xxxiii; 1884, p. 25; Waters, 1887, p. 89; Levinsen, 1909, p. 142; Harmer, 1926, p. 385, text-fig. 17.

not *Canda arachnoides* Waters, 1909, p. 165.

STATION DISTRIBUTION. *New Zealand*: Sts. 934, 935.

GEOGRAPHICAL DISTRIBUTION. Timor (Lamouroux); Australia (Busk; Waters; Levinsen; Harmer); *New Zealand* (Waters; Discovery).

I have examined Waters's specimens (kindly lent by the Manchester Museum), and confirmed the Australian and Tasmanian records (1887). The Red Sea specimens (1909) are clearly distinct from *Canda arachnoides* but not readily to be identified with a described species, though agreeing in many ways with *C. caraibica* Levinsen. The specimen from Enoshima, near Yokohama, recorded in the same paper, belongs to *C. pecten* Thornely.

Waters wrongly quoted Philipps's record of *C. retiformis* from Brazil as *C. arach-*



*noides*. Philipps (1899, p. 441) noted differences between the specimen from Brazil (90.1.30.13), which appears to have been correctly determined as *C. retiformis*, and her specimens from Lifu which have proved to belong to *C. clypeata* and *C. pecten* var. *scutata* (see Harmer, 1926, pp. 387, 389).

#### Caberea Lamouroux, 1816

Two much-discussed groups of species of *Caberea* are represented in these collections, namely, the *C. darwinii* group and the *C. boryi* group. In *C. darwinii* the outer distal border of the scutum typically meets a little projection from the outer border of the opesia so that the operculum is framed, and there is usually another small condyle-like process at the base of the stalk of the scutum (Fig. 21 A).<sup>1</sup> In *C. boryi* there is a complete calcareous bar across the orifice underlying the distal border of the scutum which is fused to it (Fig. 19 B). The bar has a suture, and it seems probable that it is formed by the fusion of outgrowths equivalent to the condyle-like processes of *C. darwinii*. The presence of a bar is associated with other characters apparently of systematic value, and, although one can imagine the bar being developed secondarily as the zooecium grows older, I have in fact found that it is laid down at a very early stage in the development of the zooecia of those forms in which it is present, and I have seen no tendency to its subsequent development in other forms. I therefore conclude that the presence or absence of a bar is a character of systematic importance.

The *C. darwinii* group as I understand it extends over a wide area, and the characters appear to intergrade in correlation with climatic conditions so that, despite the differences, in size and other characters, of the extreme forms on the fringes of the area, there may only be one species (see pp. 377, 383).

In the *C. boryi* group, on the other hand, I have given reasons for recognizing three species, *C. boryi*, *C. helicina* and *C. zelandica*, whose differences are not correlated with distribution. *C. boryi* has a wide range from the Mediterranean (perhaps England) to Australia; the other two species are known from Australia and New Zealand, and from New Zealand and Juan Fernandez respectively.

A frontal keel is a conspicuous feature of some biserial forms of *Caberea*, and most species are also more or less keeled basally. The frontal keel is formed by the oblique development of the frontal surface of the zooecia, so that they slope away from the midline of the branch. The basal keel is formed partly by the convexity of the basal surface of the branch, but chiefly by the projection of the vibracular chambers. The extent to which a branch is keeled, both frontally and basally, is best estimated from a lateral view, as can be seen in Figs. 20 A, B, 21 C, 25 D. In Fig. 25 D, for instance, there is a pronounced basal keel, while the frontal surface, being rather flat, is seen in foreshortened view. In Fig. 20 A the basal keel is less marked, but the frontal surface is so strongly keeled that the opesia and cryptocyst are in almost full view. The frontal keel may be

<sup>1</sup> Not always visible in all zooecia, unless suitably cleaned and mounted, and absent in the first-formed zooecia of the colony, and in *C. glabra* MacGillivray which may be a synonym of *C. darwinii*, see p. 381. Not shown in Busk's figures of *C. darwinii* (1884, pl. xxxii, fig. 6), but present in his specimens, see my figures (Figs. 21 A, 22 A-C).

accentuated by the presence of ovicells or large frontal avicularia. These structures project more or less in all four figures, but by comparing the position of the aperture this rather misleading feature is discounted.

The vibracula consist of a calcareous chamber containing the muscles which move the seta, a calcareous groove in which the seta rests, and, at one side, a small rootlet-chamber. The groove extends beyond the vibracular chamber, and the species differ both in the proportion of the chamber to the groove and in the proportion of the whole vibraculum to the zoecium. In *C. boryi* (Fig. 19 A) the chamber is small, the groove is small and inconspicuous (though it may be longer than in Harmer's figure), and the whole structure is small in proportion to the zoecium, leaving considerable areas of the basal zoecial wall uncovered, even when the rootlet is in position. In *C. helicina* (Fig. 20 A), *C. darwinii* (Fig. 21 C) and *C. rostrata* the chamber is larger than in *C. boryi* and the groove is much more developed, forming a larger proportion of the whole structure. More of the basal surface is thus covered and a more pronounced keel is formed. When the rootlets are present the appearance of a fairly close oblique striation of the basal surface is produced. In *C. zelandica* the chamber forms a rather larger proportion of the whole, and the vibracula lie more closely together (Fig. 20 B). In *C. angusta* and *C. transversa* Harmer (1926, p. 363) the chamber is very long, with the result that no distinction between the chamber and the extension of the groove beyond it is noticeable in the outline of the vibraculum as a whole. The vibracula are larger, and are in close contact throughout their length, covering very nearly the whole of the basal surface of the branch (Fig. 25 D).

As pointed out by Harmer a calcareous bridge is constantly present, crossing the groove near the articulation of the seta. From here nearly to the end of the vibracular chamber the floor of the groove is membranous, so that the calcareous end-wall of the chamber may form another bridge-like structure crossing the groove, as shown in *C. boryi* by Harmer. Where, as in *C. angusta* (Fig. 25 D) and *C. transversa*, the chamber is long and tapering, this second bridge is not noticeable. In *C. zelandica* (Fig. 20 B), on the other hand, the short chamber ends much more abruptly, and the appearance of a second bridge may be very marked.

#### *Key to the species of Caberea in the collection*

All the species in this key are biserial.

- |    |  |                        |
|----|--|------------------------|
| 1. | Calcareous bar <sup>1</sup> across orifice, with scutum fused to it  | 2                      |
|    | No calcareous bar, scutum may be connected to process from opposite border of opesia   | 4                      |
| 2. | Vibracular chambers small, distant from each other. Single frontal avicularia sometimes much enlarged. Marginal avicularia not enlarged...                               | 1. <i>C. boryi</i>     |
|    | Vibracular chambers <sup>2</sup> large, near together or touching, single very large frontal avicularia not present, some marginal avicularia may be moderately enlarged | 3                      |
| 3. | Branches stout, flat frontally, frontal avicularia small, proximal lobe of scutum often reduced  | 3. <i>C. zelandica</i> |
|    | Branches not particularly stout, keeled frontally, <sup>1</sup> many frontal avicularia may be moderately enlarged, proximal lobe of scutum not reduced                  | 2. <i>C. helicina</i>  |

<sup>1</sup> See p. 365.

<sup>2</sup> See p. 366.

4. Ovicells springing from about half distal border of orifice. Vibracula close together throughout their length ... .. 7. *C. angusta*  
 Ovicells springing from whole width of distal border of orifice, vibracular chambers usually not touching, grooves in contact ... .. 5
5. Scutum with pointed distal lobe, a very prominent giant frontal avicularium below many of the bifurcations, its chamber narrowing to relatively small attachment, mandible considerably longer than wide, other frontal avicularia not enlarged. Cryptocyst narrow and smooth ... .. 8. *C. rostrata*  
 Scutum with blunt distal lobe, giant frontal avicularia below bifurcation rare,<sup>1</sup> not very prominent, their chamber widening to broad attachment, mandible comparatively short, sometimes many frontal avicularia moderately enlarged, cryptocyst extensive, usually granular ... .. 4. *C. darwinii*

1. *Caberea boryi* (Audouin). Fig. 19 A, B.

*Crisia boryi* Audouin, 1826, p. 242; Cellaires Savigny, pl. xii, figs. 4<sup>1</sup>-4<sup>6</sup>.

*Caberea boryi* Harmer, 1926, p. 362, pl. xxiv, figs. 13-15; Canu and Bassler, 1928, p. 22; 1930, p. 19, pl. ii, figs. 10-12; Hastings, 1932, p. 411; Neviani, 1939, p. 23.

*Caberea boryi* (part) Busk, 1852*b*, p. 38.

not *Caberea boryi* Busk, 1852*b*, pl. xvi, figs. 4, 5 (= *C. zelandica*).

not *Caberea boryi* Busk, 1852*b*, pl. xxxviii; Busk, 1879, p. 194; Jullien 1888, p. 75; Calvet 1904, p. 7; Waters, 1905*a*, p. 232 (see *C. darwinii*).

not *Caberea boryi* Kirchenpauer, in Studer, 1889, pp. 268, 269 (fide Marcus, see p. 374 below).

not *Caberea boryi* O'Donoghue, 1923, p. 161; 1926, p. 87.

not *Caberea boryi* Hasenbank, 1932, p. 359, text-fig. 28 (= *C. darwinii* var. *occlusa*).

STATION DISTRIBUTION. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. Britain? (Busk; Hincks; Harmer); Roscoff (Waters); Mediterranean (Audouin; Heller; Waters; Canu and Bassler); Atlantic Coast of Morocco (Canu and Bassler); Madeira (Busk); South Africa (Busk; 99.7.1.304); Red Sea (1937.9.28.6); Indian Ocean (Thornely); Amboina; Japan (Harmer); Australia (Busk? Waters; Hastings); New Zealand (Discovery). See Addendum, p. 501.

Harmer (1926) redefined *Caberea boryi*.

Busk, as he himself recognized later (1884, p. 29), at one time confounded several distinct species under *C. boryi*. Neither of his plates in the British Museum Catalogue (1852*b*, pls. xvi, xxxviii) represents true *C. boryi* (see *C. zelandica* and *C. darwinii* below). Of his list of localities, Algoa Bay is confirmed by a specimen (99.7.1.304) in his collection. The specimens from South Devon are not available, but doubtless belonged to the British species, well known as *C. boryi*, whether it is Audouin's species or not (see Harmer, 1926).

The material from Cumberland Island likewise cannot be traced. Harmer accepted Busk's figs. 4 and 5 (pl. xvi) as *C. boryi*, and implied, in his synonymy, that they represented the Cumberland Island specimen. I have shown (p. 373) that they represent *C. zelandica*, and were probably drawn from New Zealand material. It follows that Harmer's conclusion that the Cumberland Island specimen was *C. boryi* was not founded on good evidence, though not improbable on geographical grounds. When

<sup>1</sup> Found in var. *guntheri*, and in less pronounced form in some Antarctic specimens.

Busk (1884, p. 29) reinstated the various forms that he had in 1852 merged in *C. boryi* (see p. 373), he identified the Cumberland Island specimen with *C. darwinii*, and it thus seems unlikely that it was true *C. boryi*. Its identity must remain uncertain, but it may well have been *C. helicina*, for *C. darwinii* is not at present known from the Queensland coast, whereas *C. helicina* is known from Broughton Island and has hitherto been confused with *C. darwinii*.

The material from Madeira (Busk, 1860, p. 281; 99.7.1.844, 845) is characteristic *C. boryi*, though fragmentary. Specimens from Glenelg (99.5.1.380) and Singapore (99.5.1.376), labelled *C. boryi* in the Hincks collection (see Hincks, 1880, p. 63), are both distinct from true *C. boryi*. The one from Glenelg is pluriserial, somewhat resembling *C. lata*. The material from Singapore is very fragmentary. It is biserial but shows none of the essential characteristics of *C. boryi*. Marcus found that Kirchenpauer's specimens were not true *C. boryi* (see p. 374 below). The identity of *C. boryi* Hutton (1873, p. 91) is also uncertain (see p. 374).

Dr O'Donoghue has kindly lent me material from Vancouver recorded by him (1923, p. 161; 1926, p. 87) as *C. boryi* Audouin. It differs from true *C. boryi* in the complete absence of scutum and oral bar, in the rarity and extremely small size of the frontal avicularia, and in the shape and larger size of the zooecia. It appears to be closely related to *C. ellisii* Fleming, which was also recorded from the Vancouver region by O'Donoghue. The zooecia and ovicells closely resemble those of *C. ellisii* in size, shape, form of cryptocyst, number of spines and absence of scutum. They differ in the small size of the vibracular chambers (a character in which they resemble *C. boryi*), and in the rarity of the frontal avicularia which are extremely small and only present on the median zooecium at the bifurcation. Except for these median zooecia, the specimens are biserial.

A specimen from Puget Sound (Busk Coll. 99.7.1.871), agreeing very closely with O'Donoghue's material, was identified by Busk with *C. ellisii*. One branch is triserial, and a few frontal avicularia are present on other zooecia than the median ones, but they are small and very rare. In other respects, including the small size of the vibracular chambers, the agreement with O'Donoghue's material is very exact. The reference to Hincks under *C. boryi* in O'Donoghue's paper (1923) is a slip. Hincks recorded *C. ellisii*, not *C. boryi*, from Queen Charlotte Island.

Fig. 19 B, drawn from a specimen from Ghardaqa, Red Sea (1937.9.28.6), shows the characteristic relations of the scutum and oral bar. The ancestrula of this specimen is closely similar in size and shape to that of *C. helicina* (Fig. 19 C).

## 2. *Caberea helicina* sp.n. Figs. 19 C, D, 20 A.

*Caberea darwinii* MacGillivray, 1886, p. 129; 1887a, p. 141, pl. cxxxvii, figs. 1, 1 a-d, 5 (not *Caberea darwinii* Busk).

? not *Caberea darwinii* MacGillivray, 1895, p. 25, pl. iii, fig. 10.

STATION DISTRIBUTION. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. Victoria (MacGillivray); Port Phillip, Victoria (87.12.10.20; 97.5.1.235; 35.3.8.1); Sydney (81.10.21.355); Broughton Island (86.12.31.9); Tasmania (1937.6.10.1); New Zealand (Discovery; St. TN 91).

HOLOTYPE. Port Phillip Heads. Bracebridge Wilson Collection, 97.5.1.235.

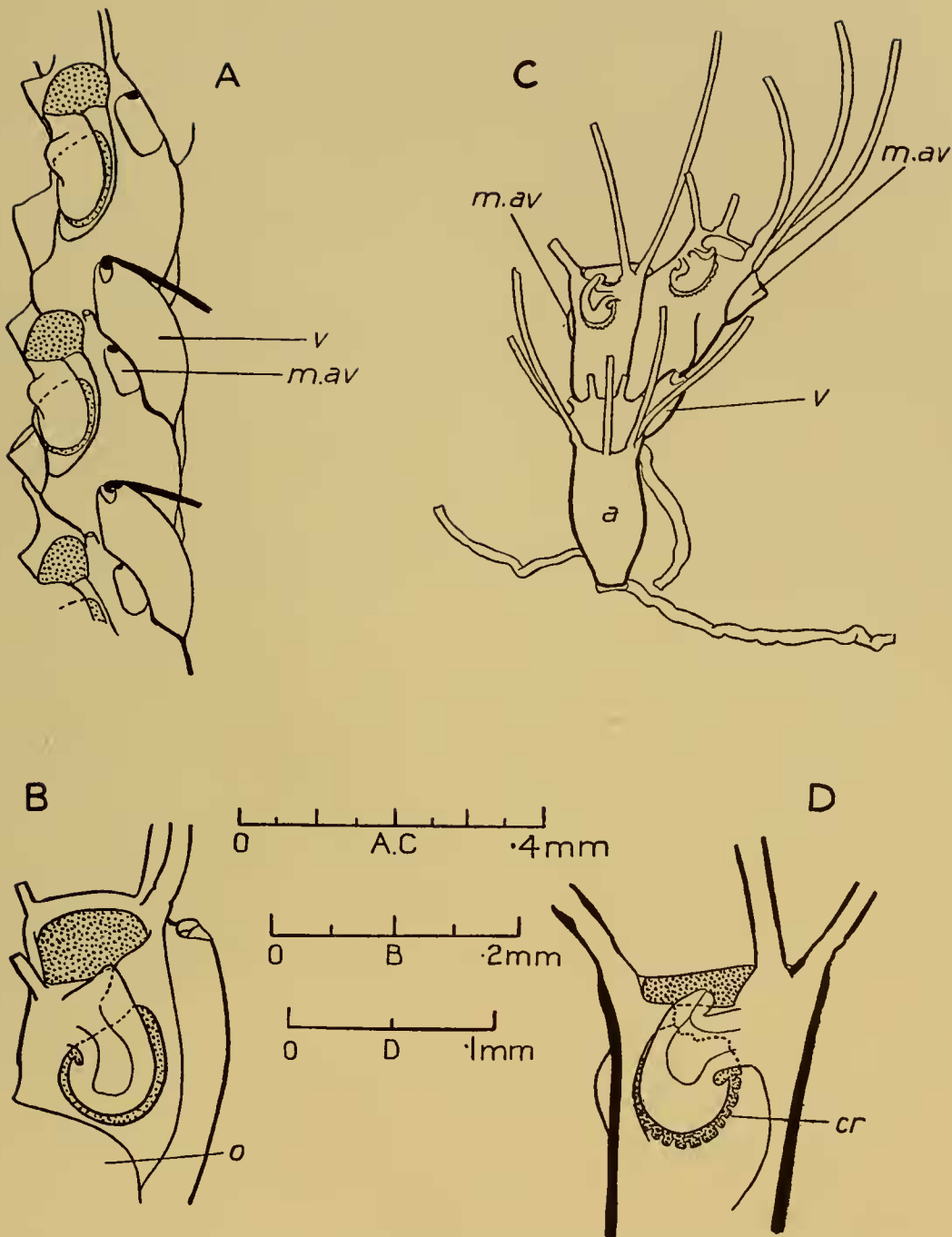


Fig. 19. A. *Caberea boryi* (Aud.). 32.4.20.106. Great Barrier Reef Expedition, St. XII. Vibracular setae cut short. B. *C. boryi* (Aud.). 1937.9.28.6. Ghardaqa, Red Sea. C, D. *C. helicina* sp.n. 35.3.8.1. Port Phillip. C. Young colony with ancestrula. D. Part of the first zooecium from Fig. C more highly magnified.

Transverse bar underlying scutum shown by dotted line. *a.* ancestrula, *cr.* crenulated edge of cryptocyst, *m.av.* marginal avicularium, *o.* ovicell, *v.* vibraculum.

This species, which was very accurately figured by MacGillivray, is distinguished from *Caberea darwinii* Busk by the characters of its scutum and cryptocyst. As in *C. boryi* and *C. zelandica*, and in contrast to *C. darwinii*, there is a thickened, oblique bar across the aperture to which the scutum is fused (Fig. 19 D). The scutum usually has a small pointed distal lobe projecting over the thickened bar and a little point on the proximal lobe, directed towards the stalk, though both may be lost. The proximal lobe fills the opesia. Its lumen becomes narrower than that of *C. darwinii*, and curved, constituting the "helicine mark" of MacGillivray. The cryptocyst is wide proximally and usually granular, and in at least some of the zooecia in every colony has a crenulate border. This border may be distinct in very young zooecia in which the granulation of the surface of the cryptocyst has not yet appeared. On the other hand, it is sometimes not discernible till the specimen has been treated with eau de javelle. Enlargement of many of the frontal avicularia is common in this species, as in *C. darwinii*, and was shown by MacGillivray in his fig. 1. When the branch is seen in profile, these avicularia may give a serrated edge to the frontal keel (Fig. 20 A). Some of the marginal avicularia may also be slightly enlarged. There are usually two outer distal spines and one peduncular spine. A second inner spine, which is also found in some specimens of *C. darwinii*, is frequently present on young zooecia.

In the New Zealand specimens from St. 934 and St. TN 91 the cryptocyst is rather smooth, though wide as in typical specimens. A line of beading is present, but is not always quite at the edge of the cryptocyst, so that it is not very conspicuous in frontal view. A third outer spine is often present and the peduncular spine may be long and stout. The vibracular chamber is rather smaller than usual, but it is not as small as in *C. boryi* and the grooves are long.

Two fragments from St. TN 144, belonging to this group of species, resemble *C. helicina* in their scuta, enlarged frontal avicularia, small marginal avicularia and moderate keel, and have long, stout peduncular spines like the other New Zealand specimens; but the cryptocyst is rather narrow and uniform in width and has a smooth edge. Though small, the colonies are mature, having ovicells and being strongly calcified.

The Tertiary species figured as *C. darwinii* by MacGillivray (1895, pl. iii, fig. 10) seems not to have had a bar across the aperture and is probably something different.

A young colony of *C. helicina* (35.3.8.1), consisting of an ancestrula and two zooecia is shown in Fig. 19 C. The ancestrula is similar in shape to that of *C. darwinii* but smaller, and has only formed one vibraculum. The first zooecium has a strongly crenulated border and a scutum of characteristic shape, but the lumen is rather restricted and does not form a helicine mark, and the oral bar is set transversely to the longitudinal axis of the zooecium, instead of obliquely. Each zooecium has a marginal avicularium.

*C. helicina* is most nearly related to *C. zelandica*, but well-developed fertile colonies of the two forms show pronounced differences. The branches of *C. zelandica* are flatter frontally and stouter (cf. Fig. 20 A and B). The cryptocyst is very little, if at all, wider proximally, and usually has a smooth edge. Rarely there is a little roughening or beading near the base of the scutum. The frontal avicularia of *C. zelandica* are small, except for

the median one at a bifurcation which may be slightly enlarged. The enlarged marginal avicularia are of similar shape in the two species, but are rare and only slightly enlarged in *C. helicina*, whereas in *C. zelandica* they are numerous and may be very large (Fig. 20 D). The proximal lobe of the scutum is usually reduced in *C. zelandica*, though specimens in which some scuta are like those of *C. helicina* in this respect are found (e.g. 99.7.1.884 and 1938.5.2.15). The two small colonies of *C. zelandica* from St. TN 144 show that the first-formed zooecia of the colony also have scuta of this type. The difference in the position of the bridge of the vibraculum which appears in Fig. 20 A, B is not constant.

Marcus (1921*b*, p. 91) regarded the form here identified with *C. zelandica* as the aged state of *C. darwinii* (in which he included *C. helicina*), but the pronounced difference between well-developed, fertile colonies of *C. zelandica* and *C. helicina* shows clearly that the relationship is not an age succession.

Marcus mentioned specimens from South-west Australia, Port Jackson, New Zealand and Carnley Harbour, Auckland Islands, as agreeing very closely with MacGillivray's description. As I have examined the material from Carnley Harbour and do not regard it as belonging to *C. helicina* (see p. 379 below) I have not included any of these records in my statement of the distribution of *C. helicina*.

### 3. *Caberea zelandica* (Gray). Plate VI, fig. 5; Fig. 20 B-D.

*Selbia zelandica* Gray, 1843, p. 292.

*Caberea boryi* (part) Busk, 1852*b*, p. 39, pl. xvi, figs. 4, 5 (*C. zelanica* on plate).

not *Caberea zelanica* Busk, 1852*a*, p. 378 (fide Busk).

*Caberea lyallii* Busk, 1884, p. 29 (nom.n. for *Selbia zelanica* [sic] Gray).

? *Caberea lyallii* Hutton, 1891, p. 103; Hamilton, 1898, p. 194; Hutton, 1904, p. 295.

? *Caberea boryi* (part) Hutton, 1873, p. 91.

*Caberea darwinii* (part) Marcus, 1921*b*, pl. v, fig. 1*a* (not *C. darwinii* Busk).

*Caberea darwinii* Marcus, 1921*a*, p. 96.

STATION DISTRIBUTION. *New Zealand*: St. 929.

GEOGRAPHICAL DISTRIBUTION. *Specimens in British Museum*: Auckland, New Zealand (Sinclair, 33.3.10.1; Busk Coll. as *C. boryi*, 1938.8.12.1); New Zealand (51.7.4.29; 75.1.5.74; 90.5.27.72; 1934.10.24.31, 32; 1938.5.2.15; Busk Coll. as *C. lyallii*, 99.7.1.881, 885; Busk Coll. as *C. lyallii* from B.Mus., 99.7.1.886; Busk Coll. as *C. zelanica* (*boryi*), 99.7.1.6549; Busk Coll. as *C. lyallii* from Lyell, 99.7.1.884, 889; Busk Coll. as *C. boryi* from Lyell, 1938.8.12.2; Busk Coll. as *C. boryi* from Colenso, 99.7.1.6612; Hincks Coll. 99.5.1.385, 391; St. 929, Discovery). Otago, New Zealand (Hincks Coll. 99.5.1.193). Palliser Bay, Wairarapa, New Zealand (90.5.27.74, 76, 100). Challenger St. 167, New Zealand (as *C. rostrata*, 87.12.9.129, and Busk Coll. 99.7.1.891). Cape Maria van Diemen (St. TN 144).

*Specimens in other collections*: New Zealand, I 88; Auckland, New Zealand, I 90 (slides lent by Dr Marcus). Masatierra, Juan Fernandez Islands, 28.3.1917, SPE 723, 30-45 m. and SPE 390 20-35 m. (Riksmuseum Stockholm 646, 645; also the specimen, I 86, figured by Marcus, 1921, pl. v, fig. 1*a*, lent by Dr Marcus).

DESCRIPTION. *Colony* thick, bushy (Plate VI, fig. 5), branching and joints typical of the genus.

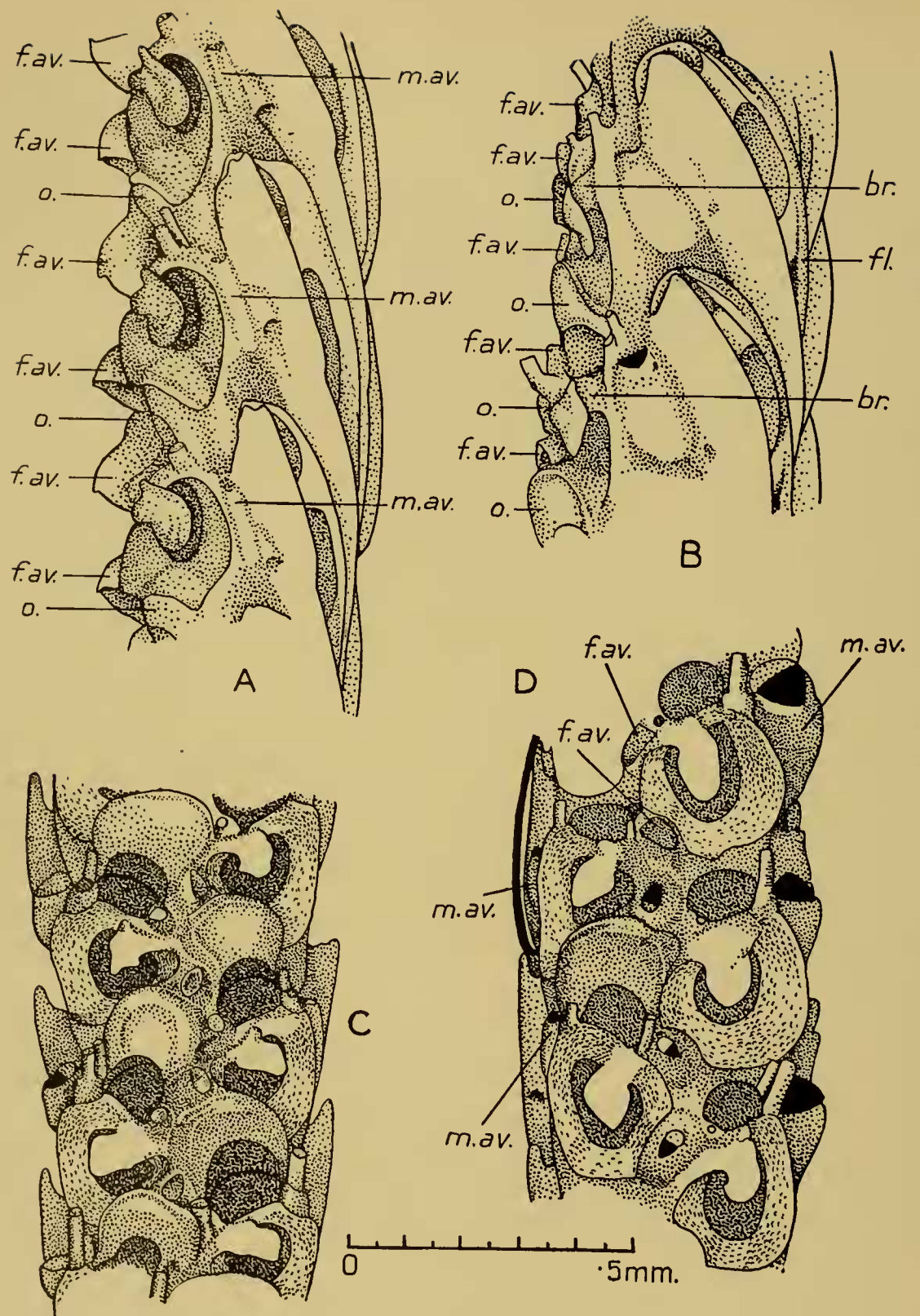


Fig. 20. A. *Caberea helicina* sp.n. 97.5.1.235. Port Phillip. Fertile branch, cleaned with eau de javelle, side view. Contrast the obliquity of the frontal surface with the flat surface of *C. zelandica*, Fig. B. B, C. *C. zelandica* (Gray). 33.3.10.1. Auckland, New Zealand. B. Fertile branch, side view. C. Frontal view. Many of the spines and avicularia are represented by scars. D. *C. zelandica* (Gray). 99.7.1.889. New Zealand. Branch with enlarged marginal avicularia on one side and small ones on the other.

All drawn from dry specimens seen by reflected light. *br.* bar, *f.av.* frontal avicularium, *fl.* flange, *m.av.* marginal avicularium, *o.* ovicell.



*Branches* biserial, rather broad and flat.

*Zooecia* (Fig. 20 C, D) with one or two outer distal spines and one peduncular spine. Cryptocyst little, if at all, wider proximally, granular except in young zooecia, edge usually smooth, rarely a little roughened or beaded near base of scutum. Calcareous bar, across opesia, forming proximal border of orifice.

*Scutum* fused to bar, distal lobe inconspicuous, proximal lobe of variable size, usually small and appearing as an appendage from bar, sometimes covering opesia and having point towards stalk as in *Caberea helicina* and *C. boryi*.

*Operculum* well chitinized.

*Frontal avicularia* small, showing usual reversal of direction on fertile zooecia.

*Marginal avicularia* with tendency to moderate enlargement, palatal surface sloping obliquely towards frontal surface of branch (Fig. 20 D).

*Vibracula* (Fig. 20 B) covering large part of basal surface, groove not very long in proportion to chamber, appearance of a second bridge may be marked (cf. p. 366).

*Ovicells* variable, usually wider than long, with large part of the ectooecium uncalcified.

REMARKS. Gray's description, which was based on material sent from New Zealand by Dr Sinclair, would apply to any biserial *Caberea*, but the only biserial *Caberea* among Sinclair's New Zealand specimens in the British Museum belongs to the present species. It is, however, probably not the specimen described by Gray. Unlike the majority of Sinclair's specimens, it bears no date, but the evidence of labelling, though not conclusive, points to its having been received with a later batch than that described by Gray in 1843. It was not named by Gray, although the other particulars are in his handwriting. There is thus no type-specimen of *C. zelandica*.

Busk used Gray's name (which he spelt *zelanica*) first for a species from Cumberland Island (1852a), and later, in the B.M. Catalogue, for the present species which he figured recognizably though not very accurately (1852b, pl. xvi, figs. 4, 5). By the time the text of the catalogue was completed he had decided to include both of these in *C. boryi*, as well as a South American *Caberea* which he had called *C. patagonica* on the plate, regarding them as variations due to "age and other circumstances". This was, however, not his final opinion, for in 1884 he reinstated the South American species as *C. darwinii*, introduced a new name, *C. lyallii*, for *C. zelandica* Gray, and pointed out that the supposed *C. zelandica* from Cumberland Island (see p. 367) was distinct from the New Zealand species. Of the specimens included in *C. boryi* in the B.M. Catalogue, only those from Devon and Algoa Bay were left in *C. boryi*, as appears from his statement of the distribution of "the true *C. boryi* of Audouin".

The sentence in which he introduced the name *C. lyallii* makes it quite clear that he believed *C. zelandica* Gray to be represented by a New Zealand species which he had formerly called by Gray's name. This could only be the New Zealand material of the B.M. Catalogue, i.e. the present species. As Busk was working on the British Museum collections when Gray was in charge of them, and only a few years after Gray's work was published, it may be assumed that at the time of writing his B.M. Catalogue he knew which species Gray intended. His figures of *C. zelandica* may thus be taken as

representing Gray's species and amplifying the original scanty description. There are inconsistencies in the *Challenger Report*, and I conclude that he reinstated *C. zelandica*, and introduced a new name for it, as an afterthought, without making all the necessary alterations in his manuscript, or relabelling all the specimens in his collection. He apparently thought the new name desirable because he had used Gray's name wrongly for the Cumberland Island specimen, but this is not a valid reason, and *C. lyallii* is a synonym of *C. zelandica*.

My conclusion that the present species is the one that Busk believed to be *C. zelandica* Gray, and for which he unnecessarily introduced the name *C. lyallii*, is supported by a number of his specimens. There is in particular a New Zealand specimen (99.7.1.886) mounted in one of the styles of the B.M. Catalogue collection, and marked as having come from the British Museum, which Busk successively labelled *C. zelanica*, *C. boryi*, *C. lyallii*. It appears not to be the figured specimen for it has no vibracular setae.

Marcus's figure (1921*b*, pl. v, fig. 1*a*) of a specimen of what he regarded as the aged state of *C. darwinii* from Juan Fernandez is a characteristic representation of *C. zelandica*. Through the kindness of Dr Marcus and of Dr Bock, I have been able to examine both the figured slide and the unmounted material, and to confirm their very close agreement with *C. zelandica*. Dr Marcus also lent me a specimen of this species from Auckland, New Zealand.

Marcus examined the material from New Zealand recorded as *C. boryi* by Kirchenpauer (1889, pp. 268, 269) and showed that, as one might expect from its abundance, it was not true *C. boryi*. As other New Zealand specimens identified by Marcus with *C. darwinii* have proved to belong to *C. zelandica* it may be that Kirchenpauer's material did also, but it is possible that it belonged to *C. helicina*.

Hutton (1873, p. 91) apparently included more than one species in *C. boryi*, and one had a complete bar. He subsequently adopted the name *lyallii*, as did Hamilton, but without indicating what species was intended.

The relationship of *C. zelandica* and *C. helicina* is discussed on p. 370.

4. *Caberea darwinii* Busk. Plate VI, figs. 1-3; Figs. 21 A-C, 22 A-C, 23 A-D, 24 A.

*Caberea darwinii* (part) Busk, 1884, p. 29, pl. xxxii, fig. 6 *c-f* (not fig. 6*a, b*, see var. *occlusa*).

*Caberea darwinii* Waters, 1897, p. 10, pl. i, figs. 13, 21-25; Kluge, 1914, p. 618; Hasenbank, 1932, p. 357, text-fig. 27 A-F.

*Caberea darwinii* (part) Marcus, 1921*b*, p. 90.

? *Caberea darwinii* Marcus, 1921*b*, pl. v, fig. 1.

not *Caberea darwinii* Marcus, 1921*a*, p. 96; 1921*b*, pl. v, fig. 1*a* (= *C. zelandica*).

not *Caberea darwinii* MacGillivray, 1886, p. 129 (= *C. helicina*).

*Caberea boryi* (part, *patagonica* on plate) Busk, 1852*b*, p. 38, pl. xxxviii (not *C. boryi* (Audouin)).

*Caberea boryi* Busk, 1879, p. 194; Calvet, 1904, p. 7; Waters, 1905*a*, p. 232.

*Crisia boryi* Jullien, 1888, p. 75, pl. xiii, fig. 5.

*Caberea minima* Busk, 1884, p. 30, pl. xxxii, fig. 5 *a, b, d* (not 5*c* = *Cellaria*).

not *Carbarea minima* Ortmann,<sup>1</sup> 1889, p. 23, pl. i, fig. 9 *a, b*.

? *Canda patagonica* d'Orbigny, 1842, pl. ii, figs. 5-9; 1847, p. 9.

? *Caberea glabra* MacGillivray, 1886, p. 129; 1887*a*, p. 142, pl. cxxxvii, figs. 2-4; 1887*b*, p. 200.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 6, 51, 56, 399, 1321, 1909, WS 82, WS 84, WS 85, WS 86, WS 87, WS 88, WS 95, WS 225, WS 231, WS 243, WS 247, WS 755, WS 847; South Indian Ocean, Sts. 1562, 1563, 1564; *Antarctic*: Weddell Quadrant, Sts. 42, 45, 140, 148, 153, 160, 167, 190, 195, 371, 1948, WS 25, WS 27, WS 33, WS 42, MS 14, MS 64; Victoria Quadrant, Sts. 1660. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region (Calvet; Waters; Discovery); Patagonian Shelf (Busk; U.S. National Museum; Discovery); New Zealand (Discovery); Auckland Island (Marcus); Tristan da Cunha; Marion Island; Prince Edward Island (Busk; Discovery); Gough Island (Discovery); off South Africa; Possession Island (Busk); Kerguelen (Busk; Hasenbank); Bouvet Island (Hasenbank); South Georgia (Calvet; Discovery; Shackleton-Rowett Expedition); Shag Rocks; South Sandwich Islands; South Orkney Islands; near Elephant Island; South Shetland Islands; Palmer Archipelago (Discovery); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition; Terra Nova; Discovery).

HOLOTYPE. 99.7.1.855, Straits of Magellan, Darwin, selected here.

A number of forms have been confused with *Caberea darwinii* Busk. Three of these have now been distinguished, namely *C. zelandica* (Gray) and *C. helicina* sp.n., described here, and *C. boryi* (Audouin), redescribed by Harmer (1926). A rather diverse collection still remains, but there is some reason for thinking that most of the variation may be correlated with differences in the climatic conditions in different parts of the wide range of a single species. Before this can be discussed the various forms must be described, and it will also be useful to record the identity and locality of certain figured specimens and to select a holotype.

FIGURED SPECIMENS. With one exception the locality from which the specimens of *Caberea* figured on pl. xxxii of the *Challenger Report* were obtained is noted on the original drawing, and in every case the drawing is accompanied by a sketch of the whole colony (only one of which was published) from which the particular colony figured can be recognized. The information is as follows: figs. 6 *a, b*, Challenger St. 142, 87.12.9.132; fig. *c*, Prince Edward Island, Challenger, 87.12.9.135; figs. *d* and *e*, Challenger St. 148, 87.12.9.136; fig. *f*, South Patagonia, Darwin, 99.7.1.856.

SELECTION OF HOLOTYPE. It seems clear, from Busk's introduction of *C. darwinii* as a new name for *C. patagonica* Busk (1852*b*, pl. xxxviii), that a specimen from Darwin's South American material should be selected as the holotype.<sup>2</sup> The choice thus lies between four specimens. Two of these (54.11.15.84, East Falkland Islands and 54.11.15.83, without exact locality) are in the collection deposited in the British Museum by Busk in 1854 (see p. 303). The other two, kept by Busk in his own collection

<sup>1</sup> Ortmann's figure does not agree with *C. minima* Busk, but neither does it, I consider, with *C. boryi* (cf. Harmer, 1926, p. 362).

<sup>2</sup> Ortmann (1889, p. 23) considered that the material figured as *C. darwinii* by Busk (1884, pl. xxxii, fig. 6) was different from *C. patagonica* Busk (1852, pl. xxxviii), with which he was inclined to merge *C. minima* Busk (1884, pl. xxxii, fig. 5). Reasons are given here for regarding all the material in question as representing one species. In any case the name *C. darwinii*, being an absolute synonym of *C. patagonica*, would not be available for the Challenger material if distinct.

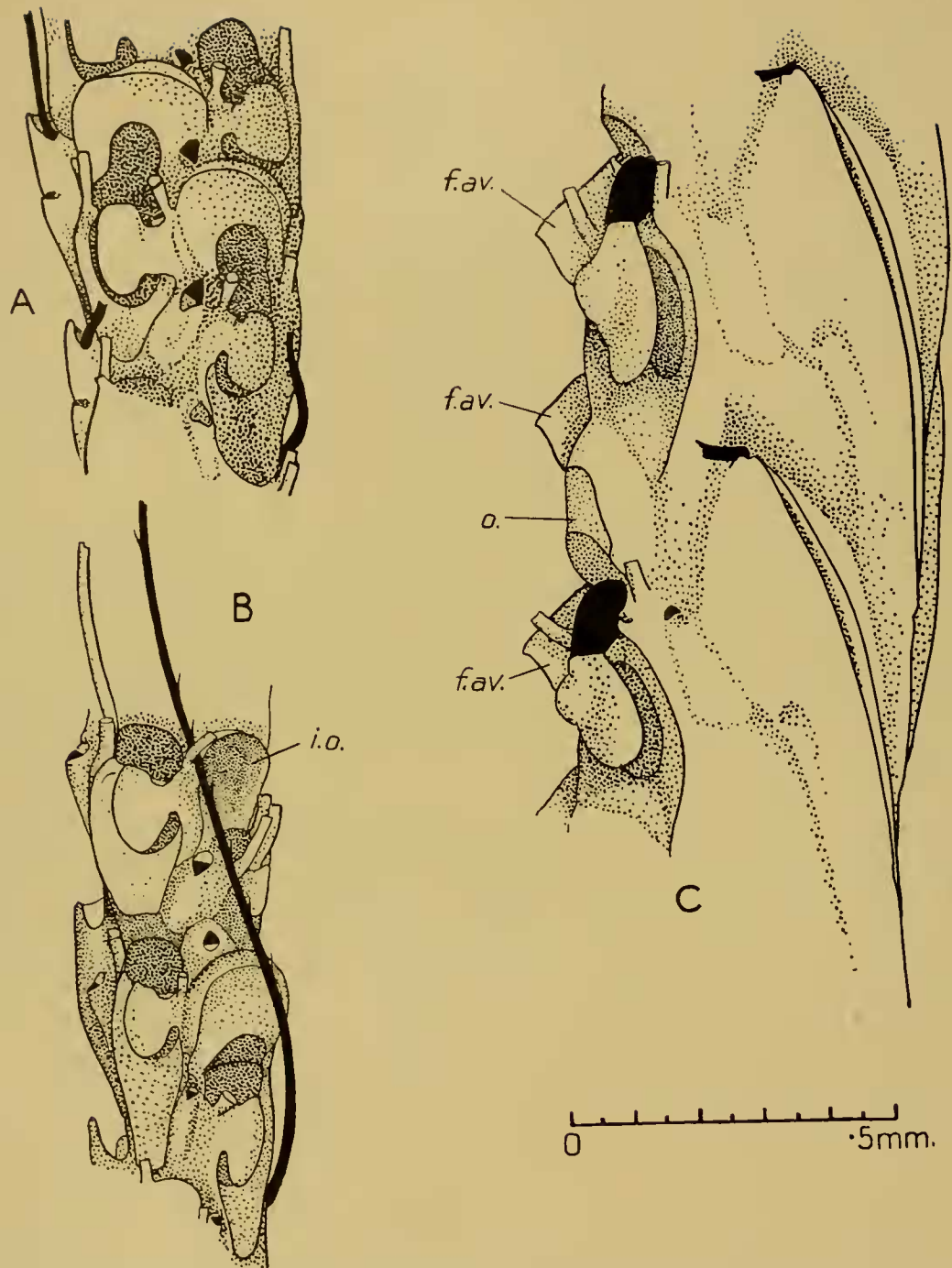


Fig. 21. A-C. *Caberea darwinii* Busk. A. Part of the type-specimen of *C. darwinii*, 99.7.1.855. Straits of Magellan, in slightly oblique frontal view. Vibracular setae curtailed. B. Part of the type-specimen of *Caberea minima* Busk, 87.12.9.144, Challenger St. 315, in slightly oblique frontal view. C. A specimen of antarctic-type, National Antarctic Expedition, McMurdo Sound. Lateral view. Vibracular setae broken. Opercula present.

All drawn from dry specimens seen by reflected light. *f.av.* frontal avicularium, *i.o.* incomplete ovicell, *o.* ovicell.

and now in the British Museum, can both be recognized as figured specimens. Of these 99.7.1.855 (Straits of Magellan) is figured ( $\times 2$ , not natural size as stated) in pl. xxxviii, fig. 1 of the B.M. Catalogue. The other, 99.7.1.856 (South Patagonia, 19 fm.) is, as we have seen, the original of Challenger pl. xxxii, fig. 6*f*. It has not been possible to determine which, if any, of these four specimens were used for figs. 2-7 in the B.M. Catalogue, but as 99.7.1.855 is the original of fig. 1, and is a complete and well-preserved colony, I select it as the holotype.

DESCRIPTION OF SPECIMENS. The holotype (Fig. 21 A), and other specimens from Darwin's collection represent one of the extremes among the specimens attributed to *C. darwini*. They are indistinguishable from *C. minima* (Fig. 21 B) which is thus, as has been suggested by various authors (e.g. Marcus, 1921*a*, p. 96), a synonym of *C. darwini*. The colonies are small, compact and fan-shaped, branching freely (cf. Plate VI, figs. 1, 2). The branches are rounded or flattened, rather than keeled, frontally. The ovicells are at least as wide as long and are only slightly oblique. There are usually two and occasionally three spines on the outer distal corner (sometimes very close together and hiding each other), one inner spine near the base of the scutum (peduncular spine), and often another inner one placed more distally (Fig. 21 A). The scutum is more or less rounded, its proximal lobe is the longer, but is not particularly long. The cryptocyst may be smooth or slightly granular. The frontal avicularia are not noticeably enlarged. The setal grooves and setae of the vibracula are relatively short.

The other extreme is represented by some of the Antarctic material of the National Antarctic Expedition. The colony consists of long, stout, rather straggling branches. The zooecia are large and long, those of the *minima* type being less than two-thirds the length of the Antarctic ones. The vibracula are large, with long setal grooves and long, stout setae. The zooecia face obliquely away from the mid-line of the branch, giving it a slight keel (Fig. 21 C), which tends to be accentuated by the enlargement of the frontal avicularia, which are placed on this line, and by the ovicells which are usually placed obliquely so that their most prominent portion comes on to the projecting median portion of the branch. The avicularium on the median zooecium at the bifurcation is commonly the largest, though not differing in shape, nor very markedly in size, from the others (Fig. 24 A). The cryptocyst is granular. The scutum has a long proximal lobe. The spines in such specimens are commonly reduced to two, a stout one at the outer distal corner and a peduncular spine near the stalk of the scutum, but the more typical arrangement with two outer and one peduncular spine is also found, and in the figured specimen the small spine distal to the peduncular spine is also present. The larger size of Antarctic specimens of this species was also noticed by Kluge.

Challenger specimens are intermediate between these two extreme types. In the specimen from St. 148, Possession Island, Crozet Group (Plate VI, fig. 3), the branches are moderately keeled (cf. Busk, 1884, fig. 6*d*), and many of the frontal avicularia are somewhat enlarged (Fig. 22 A). The zooecia and vibracula are large, the ovicells rather oblique and the cryptocyst sharply defined and granular. A single outer distal spine is usual, but there are two on some of the zooecia in the proximal part of the colony, which does not otherwise differ from the other parts.

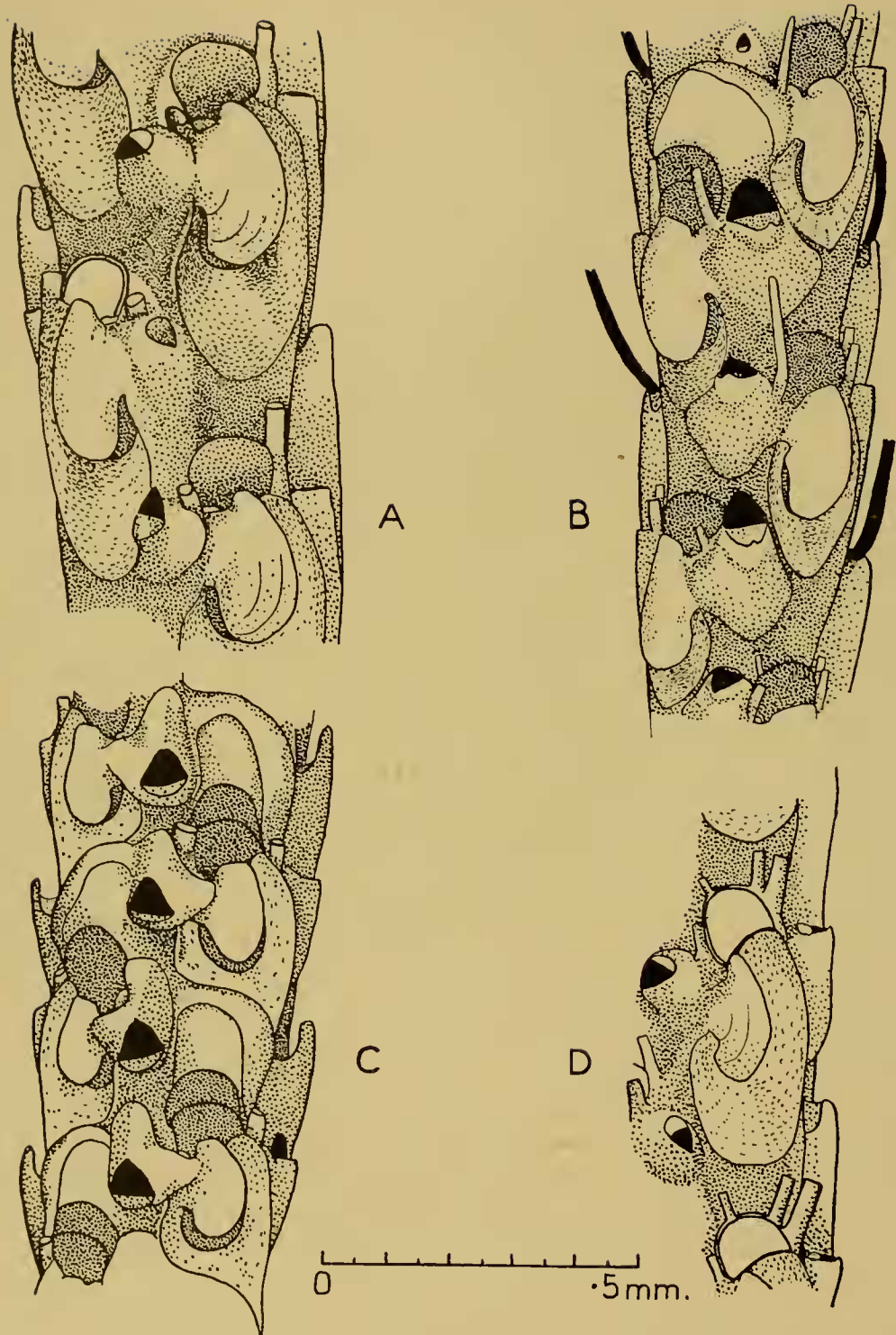


Fig. 22. A-C. *Caberea darwinii* Busk. A. 87.12.9.136. From Challenger St. 148, off Crozet Islands. Very slightly oblique view. B. 87.12.9.133. From Nightingale Island, Challenger Collection, showing enlarged frontal avicularia. C. 99.7.1.850. From Challenger St. 142, off South Africa. D. *C. darwinii* var. *occlusa* var.n. Part of the type-specimen from Challenger St. 142, 87.12.9.132. One zoecium and adjacent structures.

All drawn from dry specimens seen by reflected light.

The specimens from Swain's Bay, Kerguelen (99.7.1.846, 851, 853), recorded by Busk (1879, p. 194) as *C. boryi*, are a little less robust than those from St. 148, the frontal avicularia are less enlarged, and two outer distal spines are more commonly present. The Challenger material from Marion Island (87.12.9.134, 135, 139, 141, 99.7.1.852, 854) and one specimen from Challenger St. 142 (99.7.1.850)<sup>1</sup> resemble those from Swain's Bay (Fig. 22 C). The specimen from St. 142 has particularly large frontal avicularia on the fertile zooecia.

The Challenger specimens from Kerguelen (87.12.9.137, 142, Challenger St. 149) are exceptionally slender. The branches are not keeled, the frontal avicularia are not enlarged, and the vibracula are not quite so large as those of the colony from Possession Island. Two outer distal spines are usual.

The Challenger colonies from Nightingale Island, Tristan da Cunha (87.12.9.133, 99.7.1.847, 849) are intermediate in character between those from Swain's Bay and those of the *minima* type, the branches being of medium length and only slightly keeled and the outer distal spines usually numbering two and sometimes three (Fig. 22 B). The vibracula are a little smaller than those of the Swain's Bay specimens, and many of the frontal avicularia are enlarged. The figures of these specimens given by Waters (1897, pl. i, figs. 13, 25) are inaccurate, particularly in the relationship of the scutum and the orifice, features in which the specimens agree with those from Swain's Bay.

The specimens obtained by the National Antarctic Expedition at their winter quarters in McMurdo Sound, Ross Sea, are all of Antarctic type, but some of those taken by the 'Terra Nova' in the Ross Sea region somewhat approach the Swain's Bay type.

In the Discovery collection the majority of the specimens can be put without hesitation into one of three groups (*minima* type, robust Antarctic type, and intermediate Swain's Bay type) described above. The specimens that cannot readily be placed form two groups, one intermediate between the *minima* and Swain's Bay types, the other between the Swain's Bay and Antarctic types.

SYNONYMY. In view of the ease with which the condyle-like process near the base of the operculum (see p. 365 above) can be overlooked, and considering their locality and their agreement with *C. darwinii* in other respects, I accept Hasenbank's figures of specimens from Bouvet Island as representing *C. darwinii*. The zooecium in Fig. A is as large as those of Antarctic type, but in other respects (e.g. spines and frontal avicularia) is of less extreme character. Fig. F approaches the *minima* type, but resembles *C. glabra* (see p. 381) in the shape of the scutum as well as in the absence of the condyle-like process. The zooecium is, however, larger.

Marcus (1921 a) mentioned that the material from Juan Fernandez was of the strongly calcified type, with short, broad zooecia, which he regarded as the aged state of *C. darwinii*. I have shown above (p. 374) that his specimens of this type from both Juan Fernandez and Auckland, New Zealand, belong to *C. zelandica*. His unmounted material from Carnley Harbour, Auckland Island, 6.12.1914 (Marcus, 1921 b, p. 91), kindly lent me by the Copenhagen Museum, agrees with typical *C. darwinii* (*minima*

<sup>1</sup> The other specimens from this station belong to var. *occlusa*, see p. 385

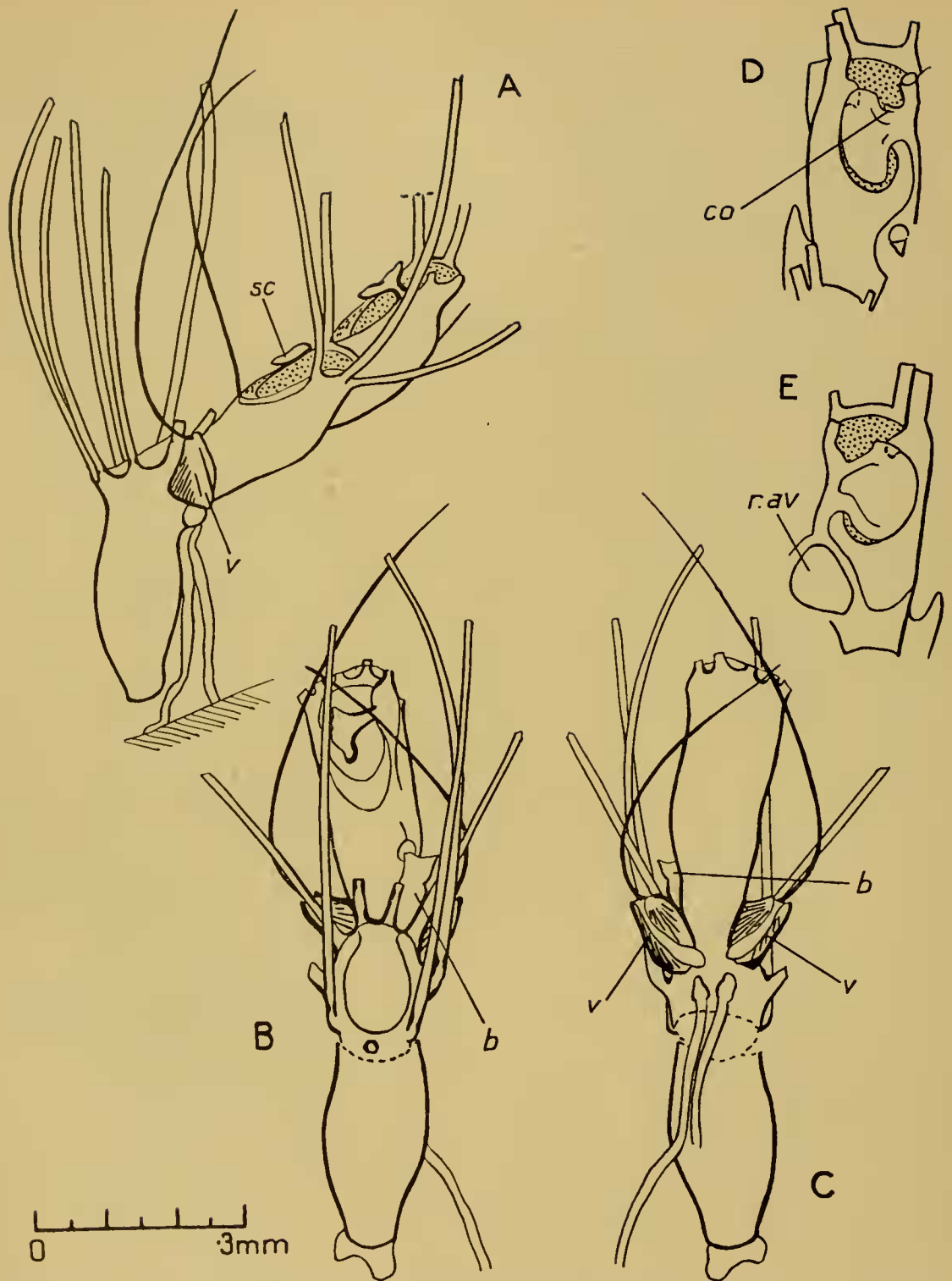


Fig. 23. A-D. *Caberea darwinii* Busk. A. Young colony with ancestrula from St. 1563, Marion Island. Lateral view. B, C. Young colony from St. TN 339, Ross Sea, frontal and basal views. The ancestrula is broken (dotted line) and the colony is flattened (notice the angle between the ancestrula and zoecia in Fig. A). D. Zoecium from a specimen of the *minima* type, from St. 1321, Straits of Magellan. E. *C. glabra* MacGillivray. 99.5.1.378, Port Phillip Heads.  
*b.* bud of second zoecium, *co.* condyle-like process, *r.av.* rudiment of frontal avicularium, *sc.* scutum, *v.* vibraculum.



type). The figured specimen (pl. v, fig. 1) from Auckland Island lent me by Dr Marcus<sup>1</sup> is, however, rather different. Its zooecia are about the same size as those of the *minima* type, but it has a more granular cryptocyst and a scutum with a longer narrower distal lobe and a longer stalk, and, although a small process is present, the scutum is not connected distally with the opposite cryptocyst.

It is unlikely that Stach's record of *C. darwinii* (1937, p. 378) from Lady Julia Percy Island, Bass Strait, was based on true *C. darwinii*.

I have been unable to trace Busk's specimen from Cumberland Island, recorded in the B.M. Catalogue as *C. boryi*, and later (1884) referred to *C. darwinii* (see p. 373 above).

I have examined *C. boryi* Waters (1905a) from Cape Horn, kindly lent me by the Manchester Museum, and find that it is a specimen of *C. darwinii* approaching the *minima* type. I agree with Marcus that it may confidently be assumed that both Jullien (1888) and Calvet (1904) had *C. darwinii*. It is clear from Calvet's statement of distribution that he did not distinguish *C. boryi* and *C. darwinii*, and there is no evidence that true *C. boryi* has ever been found in the South American region.

It is hardly necessary to mention that Busk's pl. xxxii, fig. 5c, does not represent a *Caberea*. The young *Cellaria* from which it was drawn is still attached to the type-specimen of *Caberea minima*.

*C. glabra* MacGillivray (Fig. 23 E), whose resemblance to *C. darwinii* was noticed by Marcus (1921b, p. 91), remains to be considered, and my material has been insufficient to settle its position. Two typical colonies from Port Phillip (Bracebridge Wilson Coll. 88.11.14.422, 97.5.1.238<sup>2</sup>) closely resemble the *minima* type of *C. darwinii*. The chief distinction lies in the absence, in *C. glabra*, of the little condyle-like process at the base of the stalk of the scutum, to which the operculum articulates in *C. darwinii* (cf. Fig. 23 D, E). As a result, the scutum appears longer-stalked in *C. glabra*, although the stalk is often stouter and the lobes less clearly marked off from it than they are in *C. darwinii*. The distal lobe of the scutum is usually narrower and often pointed and turned a little forwards (i.e. frontally), whereas, in *C. darwinii*, it is broad and blunt, but there is a good deal of variation. No zooecium of typical *C. glabra* has been seen with three outer spines as is sometimes seen in the *minima* type of *C. darwinii*, but the peduncular spine may be long and stout. In both *C. darwinii* and *C. glabra* a small inner spine, distal to the peduncular spine, may be present. The frontal avicularia are on the whole larger in *C. glabra* than in the *minima* type, and the one on the median zooecium at a bifurcation is often the largest, though not greatly enlarged in typical specimens. As in the *minima* type, the cryptocyst may be smooth or granular. The presence of *C. glabra* at South Trinidad Island, off Brazil (Terra Nova Coll.), in latitudes comparable to those of its Australasian localities, suggests that it is a further term in the *darwinii* series (see p. 382),

<sup>1</sup> It is mounted on the same slide (I 86) as the figured specimen of *C. zelandica* from Juan Fernandez.

<sup>2</sup> There is also a colony from Port Phillip (Hincks Coll. 99.5.1.378), identified by Hincks with *C. darwinii*, which agrees with the Wilson specimens, and the same characteristics are seen in colonies from Tasmania (99.7.1.888, 34.1.18.4), South Australia (99.7.1.887), Port Phillip (1938.8.2.1, 99.5.1.392), New Zealand (St. 934 and St. TN 144). Stach (1937, p. 378) recorded *C. glabra* from Lady Julia Percy Island in Bass Strait.

representing the growth of *C. darwinii* in the warmer waters north of the sub-Antarctic region. The presence of the *minima* type of *C. darwinii* at Auckland Island in sub-Antarctic water south of the New Zealand localities of *C. glabra* also supports this idea. The matter is, however, not as simple as this, for small colonies from St. 934, north of New Zealand, appear to represent the *minima* type of *C. darwinii*, some, at least, of the zooecia having a process at the base of the scutum, and three outer spines being found. These colonies have very long, stout, peduncular spines.

The question is further complicated by the existence of specimens from New Zealand and Japan, agreeing in their main characters with *C. glabra*, but diverging in various ways from the typical specimens. The New Zealand material from St. 934 and St. TN 144 is chiefly remarkable for the stoutness of the peduncles of the scuta, but one specimen from each station has giant frontal avicularia, and scuta with a broader, straight-edged distal lobe. The older zooecia of these young colonies have three outer distal spines. Another specimen from New Zealand (Busk Coll. 99.7.1.5014) has giant frontal avicularia which are rather broader and blunter than those of the other specimens. Although connected distally, the scuta have a much smaller blade than those of typical *C. glabra*, with a small blunt proximal lobe and a pointed distal lobe. Specimens from the south coast of Japan (78.1.10.14) resemble Hincks's New Zealand specimen in their giant frontal avicularia, but in other respects agree with typical *C. glabra*.

We have also the form described by MacGillivray (1887*a*, p. 142, pl. cxxxvii, fig. 4) as *C. glabra* var. *dolabrata* in which giant frontal avicularia are not found, the scuta resemble those of Hincks's New Zealand specimen in outline, but are not connected distally, and the peduncular spines are exceptionally long and stout. This form is represented in the British Museum by an unmounted colony from Port Phillip (87.12.10.34), and six slides, coming from Port Phillip (99.7.1.882), Warrnambool (99.5.1.382, 383, "Warnamboul" on labels), Flinders Island (86.25.29.30, 31) and Puebla Bay (88.11.14.379), all in the Victorian region.

Only the examination of more material could determine the relationship of this group of Australasian and Japanese forms (including *C. glabra*) to *C. darwinii* and to each other.

Young colonies of *C. transversa* Harmer (including those from the Barrier Reef, Hastings, 1932, p. 411) are hardly to be distinguished from typical *C. glabra*, although adult colonies are much more robust and differ clearly from adult colonies of *C. glabra* in the shape of scuta and ovicells, and in the larger, more closely placed, vibracula. Bassler's material of *C. transversa* from the Philippines (31.12.30.69) agrees closely with the type in these respects.

DISCUSSION OF DISTRIBUTION. It will be noticed that, although *C. darwinii* has several times been recorded from Japanese localities, I have omitted Japan from the distribution. These records are without supporting evidence. Even the diagnosis accompanying Okada's record of a "small specimen" (1934, p. 8) is not a description of the actual specimen but a quotation, almost verbatim, of Busk's definition. The species is typically Antarctic and sub-Antarctic, and has not been recorded from the Malay Archipelago, the China Sea, Northern Australia, or Queensland, so that its occurrence in Japan

seems improbable, and I am inclined to await further evidence before accepting it as Japanese. Possibly some of the Japanese records are based on *glabra*-like specimens such as are discussed on p. 382.

The known area of distribution of *C. darwinii* (see p. 375) corresponds very closely to the sub-Antarctic and Antarctic regions of the southern ocean as limited, at the surface, by the subtropical convergence (see Fig. 59, and Deacon, 1933, 1937), though the species extends as far north as South Trinidad and the north of New Zealand (see p. 382).

Table 1. *Summary of distribution of Caberea darwinii and Caberea glabra*

The heavy lines A and B mark the positions of the subtropical and Antarctic convergences (see Fig. 59). The localities in the subtropical and sub-Antarctic zones are arranged according to their distance northward from the convergence that constitutes the southern limit of the zone. The Antarctic localities are arranged from north to south according to latitude. New Zealand lies across the subtropical convergence, but the specimens come from the northern part of the islands.

	A									B							
	Subtropical			Sub-Antarctic						Antarctic							
	South Trinidad	Challenger St. 142	New Zealand	Tristan da Cunha	Auckland Island	Patagonian Region	Prince Edward Island	Marion Island	Possession Island	Kerguelen	South Georgia	Bouvet Island	South Sandwich Islands	South Orkney Islands	South Shetland Islands	Palmer Archipelago	Ross Sea
<i>Caberea glabra</i> *	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Caberea darwinii</i> :																	
<i>Minima</i> type	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Approaching <i>minima</i> type	.	.	.	+	.	+	.	.	.	.	+†	?†	.	.	.	.	.
Swain's Bay type	.	+	.	+	.	+	+	+	.	+	+	+	.	.	.	.	.
Approaching Antarctic type	.	.	.	.	.	.	.	.	+	.	+	?†	+	.	.	.	+
Antarctic type	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	+

\* Also known from Victoria and Tasmania. For discussion of related forms see p. 381.

† Single specimen from shallow water.

‡ Based on Hasenbank's figures, see p. 379.

Table 1 shows the distribution of the different types of colony and a general tendency is at once apparent, the small *minima* type being found to the north, the robust Antarctic type to the south, and the intermediate types forming a roughly graded series in the intermediate regions.<sup>1</sup>

The chief exception appears to be the colony of Swain's Bay type from Challenger St. 142 which is off South Africa and north of the subtropical convergence (35° 4' S,

<sup>1</sup> A specimen of Swain's Bay type from near Elephant Island was discovered too late for inclusion in Table 1. As it should come between the South Orkney and South Shetland Islands it extends the range of this type southward.

18° 37' E, 150 fm. = 275 m.). The nearest Discovery stations at which soundings were taken were St. 102 at 35° 29' 20" S, 18° 33' 40" E, in 1800 m., and St. 407 from 35° 13' S, 17° 50½' E to 34° 57' S, 17° 48' E in 2822 m. It is thus evident that Challenger St. 142 must have been on the slope of the continental shelf. Hydrological data are rather scanty, but the 'Discovery' took a series of temperatures at St. 102 which shows a uniform temperature down to 50 m. after which the temperature falls, the maximum fall being between 150 and 200 m. In this connexion it is worth noticing Deacon's reference (1937, p. 57) to a northward-flowing current of sub-Antarctic water at 200 m. in the region of the subtropical convergence south of South Africa. These are mere hints, but they suggest that hydrological conditions off the continental shelf in the South African region may be such as to account for the occurrence there of specimens of *C. darwinii* of more southerly type.

To get a rough idea of the relationship of the whole fauna at Challenger St. 142 the list given by Murray (1895, p. 416) was examined. At that time about 45% of the species were not known elsewhere. Of the remainder, more than a third were also taken at sub-Antarctic stations.

The occurrence of specimens approaching the Antarctic type at Possession Island (Challenger St. 148) may perhaps be related to the greater depth at which they were obtained, the dredgings being made at 210–550 fm. as compared with 20–127 fm. at Kerguelen and 50–150 fm. at Prince Edward Island (Murray, 1895, pp. 439, 458, 475). The relationships of the other Cellularine Polyzoa of these islands are discussed on p. 483.

Where two or more types are found in the same region, there are some indications of a correlation with depth, despite the small range of depth represented (see, for example, Tables 4 and 5, pp. 487, 490, showing the range of depth at South Georgia and in the Patagonian region), but it is very inexact, as might be expected in view of the complicated depth relations of the different types of water.

The smaller zoecia, flat branches, greater number of spines, and less specialized vibracula, scuta and avicularia, are all features of *C. minima* which can be regarded as juvenile, and one does in fact find some gradation in these characters as one passes from the base to the tip of some colonies. I have not, however, found the whole range in any one specimen, and the correlation with geographical distribution is enough to show that it is not simply a case of the gradual assumption of the adult characters as the colony grows. The distribution of certain species of *Amastigia*, discussed on p. 325 is comparable.

ANCESTRULAE. Ancestrulae attributed to *Caberea darwinii* were obtained from Marion Island and Prince Edward Island (Sts. 1562, 1563, 1564, 7. iv. 35, 12 ancestrulae), the Burdwood Bank (St. WS 87, 3. iv. 27, 1 ancestrula), South Georgia (St. 42, 1. iv. 26; St. WS 33, 21. xii. 26; St. WS 42, 7. i. 27, 3 ancestrulae), off Oates Land (St. TN 194, 22. ii. 11, 2 ancestrulae), Ross Sea (St. TN 339, 24. i. 12, 1 ancestrula), and McMurdo Sound (National Antarctic Expedition, 28. ii. 02, 2 ancestrulae).

The ancestrula is vase-shaped, with spines all round the obliquely terminal opesia and the colony is slung by rootlets (Fig. 23 A–C). The first two, or more, zoecia have more than the typical number of spines, and no frontal avicularia. Scuta, with a well-

developed distal lobe, are present on them, and neither the projection from the outer margin of the opesia nor that at the base of the stalk of the scutum is present. The cryptocyst is narrow and the vibracula small. On succeeding zooecia, frontal avicularia appear, the spines decrease in number, the cryptocyst becomes wider proximally and more granular, the scutum becomes blunter distally and meets a lobe from the opposite edge of the opesia, and the vibracula increase in size, until the typical adult characteristics are attained.

From Marion Island there are several young colonies which have not advanced far enough to show the characteristics of the species but agree so closely with the corresponding parts of the more advanced colonies that they are identified with fair certainty. The young colony from St. TN 339 (Ross Sea), shown in Fig. 23 B, C, is similar. In it the ancestrula was lightly attached by a membranous vesicle as well as by a pair of rootlets springing from the bases of the two first zooecia. The vesicle evidently represents the primary attachment by which the ancestrula was fixed before the rootlets developed, and no doubt other ancestrulae, now slung by rootlets, were originally attached in the same way. In some of them the remains of the vesicle can be seen.

A few ancestrulae which have not yet given rise to a whole zooecium have also been identified with *C. darwinii* on the strength of their agreement in shape, and the presence of less dubious specimens from the same stations. It is interesting to see that the first pair of rootlets, and the vibracula belonging to the first two zooecia, may be fully formed while the buds of the zooecia are still at a very rudimentary stage. On the other hand, one of the specimens with a fully formed first zooecium has only one vibraculum.

The fifteen ancestrulae from Marion Island, Prince Edward Island and South Georgia range in length from 0.34 to 0.42 mm., the average being 0.37 mm. The four ancestrulae from the Ross Sea region are larger, ranging in length from 0.42 to 0.50 mm., average 0.46 mm., which suggests that the ancestrulae, like the other zooecia, are larger in the Antarctic. This might perhaps be expected, but more Antarctic ancestrulae would be needed before it could be regarded as established.

5. *Caberea darwinii* var. *occlusa* var.n. Fig. 22 D.

*Caberea darwinii* (part) Busk, 1884, p. 29, pl. xxxii, fig. 6a, b.

*Caberea boryi* Hasenbank, 1932, p. 359, text-fig. 28.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. South Africa (Busk; Hasenbank).

HOLOTYPE. Challenger St. 142, 35° 4' S, 18° 37' E, 150 fm., 87.12.9.132.

One colony from Challenger St. 142 has already been described among the specimens of *C. darwinii* (p. 379), but two others (87.12.9.132, 138) appear to represent a distinct variety. In them the cryptocyst on the outer distal side of the opesia is expanded in such a way that three-quarters of the proximal border of the operculum is in contact with the distal edge of the cryptocyst, the remaining quarter being connected with the small process from the other side of the opesia and with the very narrow distal lobe of the scutum (Fig. 22 D). The inner distal spine is rather constantly present.

As in many specimens of *C. darwinii*, there are many moderately enlarged frontal avicularia.

Hasenbank's figure shows all these peculiarities and clearly represents this variety. He recorded *C. boryi* from four South African stations, and he has kindly informed me that the figured specimen came from St. 114, which was in Simon's Bay at 70 m. Challenger St. 142, on the other hand, was on the edge of the continental shelf (see p. 384).

Although this variety shows some resemblance to *C. boryi*, I am satisfied that its affinities are with *C. darwinii*. It differs from *C. boryi* in its extensive, granular cryptocyst, in the absence of an oral bar, in the large vibracula which almost completely cover the basal surface, in the absence of giant frontal avicularia and the presence of many moderately enlarged ones. In all these respects it resembles *C. darwinii*, particularly specimens of the Swain's Bay type. In the part played by the cryptocyst of the outer side of the opesia in the formation of the proximal lip of the orifice, it far exceeds *C. boryi*, and in this respect it is distinct from both *C. boryi* and *C. darwinii*. In *C. boryi* the outer cryptocyst forms less than half the lip and widens towards the orifice to do so (see Fig. 19 B and Harmer, 1926, pl. xxiv, fig. 13). In var. *occlusa* the cryptocyst forms fully three-fourths of the lip, although it is little, if at all, wider in that part. The variation of typical *C. darwinii* shows that size may be of little systematic significance, but it should be mentioned that the zooecia of var. *occlusa* are larger than those of *C. boryi* (cf. Figs. 19 A and 22 D in which the difference in size is quite marked despite the greater magnification of the drawing of *C. boryi*).

The original drawing of fig. 6b in the *Challenger Report* is accompanied by a sketch of the whole colony (reproduced in the *Report* as fig. 6a) which can be recognized as representing the colony now made the type of var. *occlusa*. This indication of the identity of the specimen figured by Busk is confirmed by the fact that the actual branch shown in fig. 6b can be recognized from the accuracy with which certain details are drawn. Despite this, the drawing of the scutum and cryptocyst is inaccurate and shows none of their peculiarities. My Fig. 22 D is drawn from the same specimen.

6. *Caberea darwinii* var. *guntheri* var.n. Plate VI, fig. 4; Fig. 24 B.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 840, WS 871.

GEOGRAPHICAL DISTRIBUTION. Off Patagonian Shelf, below 336 m. (Discovery).

HOLOTYPE. St. WS 840.

These specimens differ from typical *C. darwinii* in the presence of gigantic avicularia, placed proximally to many of the bifurcations, the other frontal avicularia being small (Fig. 24 B). The gigantic avicularia have a broad mandible, and the avicularian chamber spreads proximally over the peduncles of the scuta of neighbouring zooecia, forming lobes of which the more proximal is usually long and pointed. The extensive cryptocyst is finely and evenly granular as seen in dry specimens, but may appear almost smooth in a balsam preparation.

In the relatively luxuriant growth of the colonies (Plate VI, fig. 4), in the large size

of the zooecia and vibracula, in the number of spines, and in the keeled frontal surface of the fertile branches, this variety resembles the Antarctic form of *C. darwinii*. It differs in the small size of all the frontal avicularia except those on the median zooecia at the bifurcations, and in the large size and characteristic shape of these median avicularia. In the Antarctic form the avicularium on the median zooecium may be larger than the other frontal avicularia, but all are more or less enlarged and of similar shape so that there is not the marked contrast that is found in this variety (cf. Fig. 24 A, B).

Coming from the region of the Falkland Islands and showing so many of the characteristics of the Antarctic type var. *guntheri* seems at first sight to disagree with the distribution of *C. darwinii* as summarized on p. 383. The stations at which the variety replaced

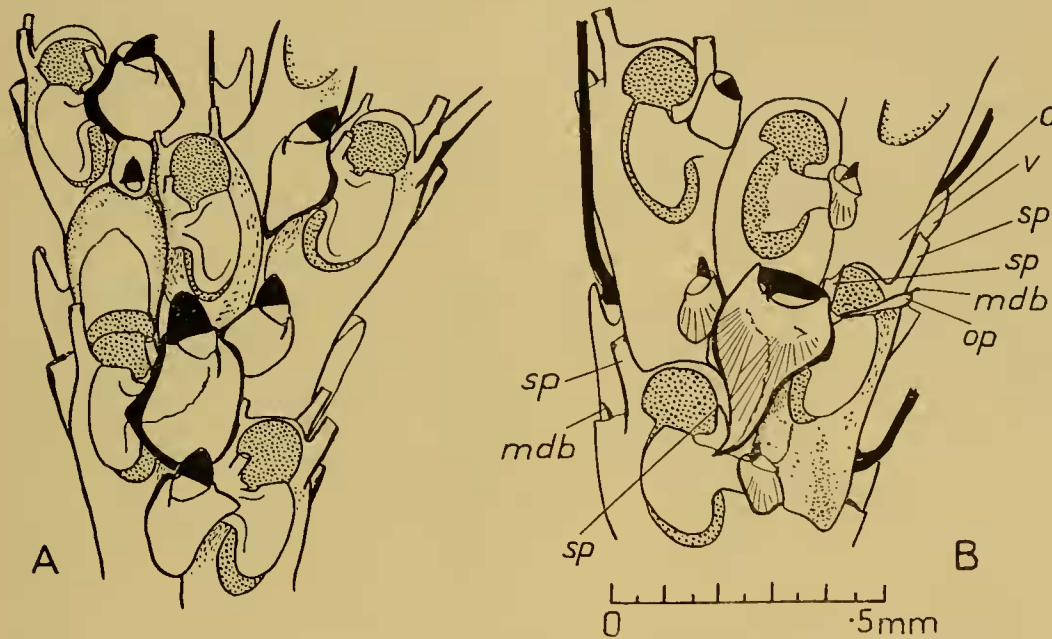


Fig. 24. A. *Caberea darwinii* Busk, Antarctic type. National Antarctic Expedition, McMurdo Sound. B. *C. darwinii* var. *guntheri* var.n. St. WS 840, between Burdwood Bank and Patagonian Shelf. Both drawings show the zoecia immediately preceding a bifurcation. In Fig. B the scutum of the median zooecium is broken, and the granulation of the cryptocyst has been omitted from all but one of the zooecia.

c. cryptocyst, mdb. mandible, op. operculum (open), sp. spine, v. vibraculum.

the typical form are, however, the deepest from which Polyzoa were obtained in the Patagonian region, and there is some reason to think that they are influenced by Antarctic conditions (see p. 486).

The form from Juan Fernandez figured by Marcus (1921a, p. 98, text-fig. 1a) as *C. rostrata* (see p. 390 below) also has a giant avicularium before the bifurcation, with the chamber spreading proximally, but with a longer mandible, and no pointed prolongation of the chamber. Spines are more numerous than in var. *guntheri*, and the zooecia are smaller and have a smooth cryptocyst with no marked proximal widening. The scuta are similar in shape and have a distal connexion, as in *C. darwinii*, but the condyle-like

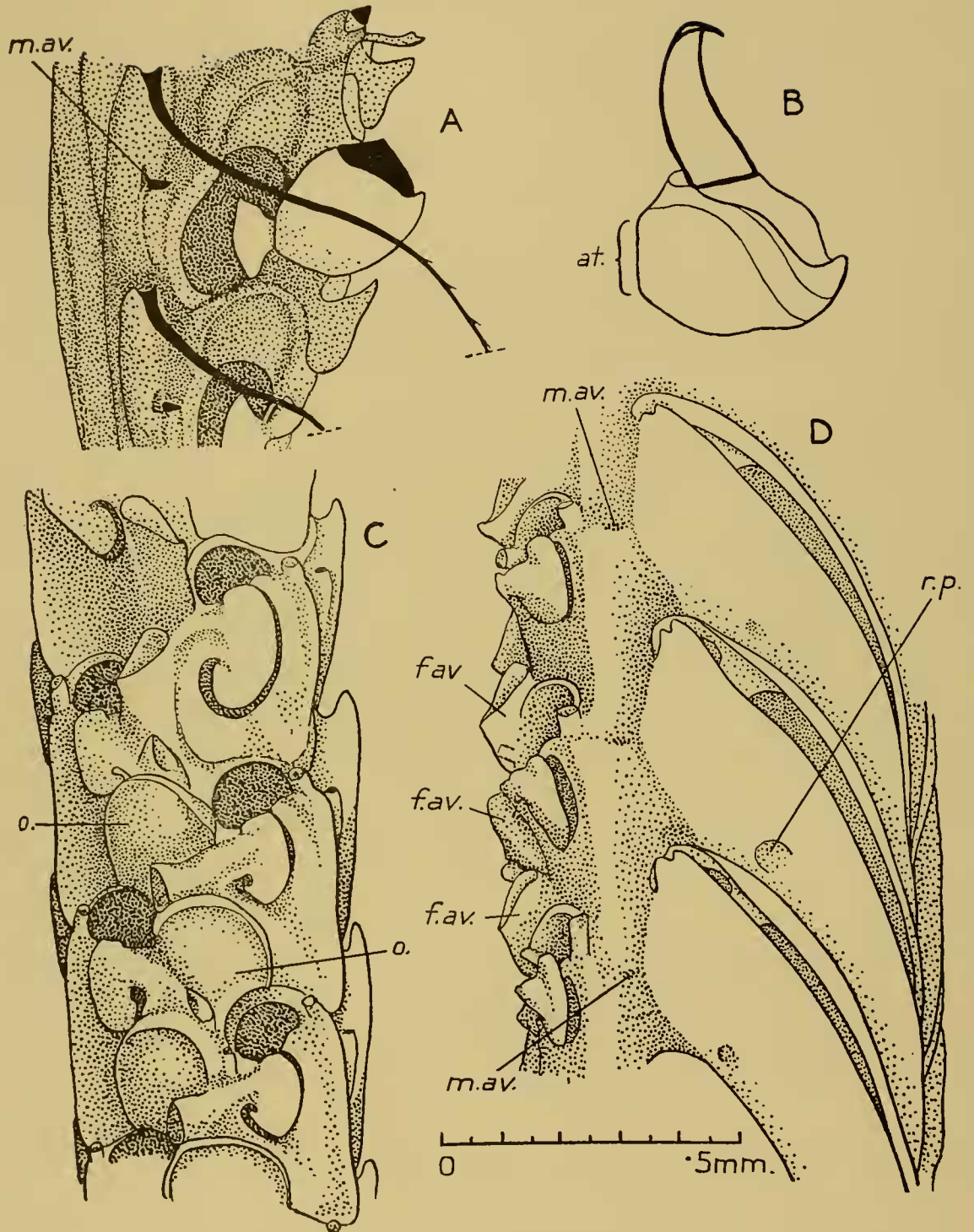


Fig. 25. A, B. *Caberea rostrata* Busk. A. From St. 5, Tristan da Cunha. Oblique view. Vibracular setae curtailed. B. Large avicularium from type-specimen, Challenger St. 167, New Zealand, 87.12.9.128. C, D. *C. angusta* sp.n. St. 935, New Zealand. C. Slightly oblique frontal view showing ovicells. D. Lateral view, without ovicells.

All drawn from dry specimens seen by reflected light. *a.t.* area of attachment of avicularium, *f.av.* frontal avicularium, *m.av.* marginal avicularium, *o.* ovicell, *r.p.* rootlet-pore.



process at the base of the stalk, which is well developed in var. *guntheri*, is absent in the Juan Fernandez species.

7. *Caberea angusta* sp.n. Fig. 25 C, D.

STATION DISTRIBUTION. *New Zealand*: Sts. 934, 935.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Discovery).

HOLOTYPE. St. 935.

DESCRIPTION. *Colony* with branching and joints typical of genus. Rootlets calcified. *Branches* rather stout, biserial, strongly keeled basally, rather broad and flat frontally (Fig. 25 D).

*Zooecia* usually with two distal spines (one outer, one peduncular), peduncular spine frequently hidden by or fused to frontal avicularium (Fig. 25 C). Aperture occupying whole frontal surface (no frontal gymnocyst). Cryptocyst wide, extra wide proximally when proximal zooecium fertile. No apertural bar.

*Scutum* meeting stout hooked process from opposite border of aperture. Distal lobe blunt, proximal lobe covering aperture, with a point towards stalk.

*Frontal avicularia* small and directed distally when distal to an ovicell, otherwise moderately large, with long mandible directed obliquely backwards.

*Marginal avicularia* very small (Fig. 25 D).

*Vibracula* large, oblique and in close contact with each other.

*Ovicells* small, narrow, springing from little more than half distal border of orifice of fertile zooecium, leaving about two-thirds of width of cryptocyst of distal zooecium uncovered between ovicell and margin of the branch (Fig. 25 C).

REMARKS. *C. angusta* differs from all other species of *Caberea* known to me in its narrow ovicells which spring from about half the distal border of the orifice and occupy the middle of the branch. In other ways it may be compared with *C. darwinii* which it resembles in its wide cryptocyst and the connexion of the scutum with the cryptocyst. It differs in the large size of the vibracula in proportion to the zooecia, the vibracula being larger than those of the Antarctic type of *C. darwinii*, the zooecia rather shorter than those of the Swain's Bay type, but broad. It follows that the vibracula have to lie more obliquely, are in close juxtaposition, and form a pronounced keel (cf. Figs. 21 C and 25 D). The frontal surface, on the other hand, is flat. The frontal avicularia have a longer narrower mandible, and, in the absence of ovicells, form an almost continuous zigzag series down the middle of the branch. The point on the proximal lobe of the scutum also distinguishes *C. angusta* from *C. darwinii*.

8. *Caberea rostrata* Busk. Fig. 25 A, B.

*Caberea rostrata* Busk, 1884, p. 28, pl. xxxii, fig. 4 a-d; Livingstone, 1929, p. 54.

not *Caberea rostrata* Marcus, 1921 a, p. 95, text-fig. 1 a, b.

not *Caberea rostrata* Waters, 1887, p. 90.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 4, 5, 1187.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Busk; Livingstone; Terra Nova); *Tristan da Cunha* (Discovery).

The type specimen of this species is a complete, mounted colony (87.12.9.128), and agrees well with Busk's description and figures, as do some fragments (99.7.1.892 Busk Coll.) from the same station. A large colony in spirit and some mounted pieces (87.12.9.129 and 99.7.1.891 respectively) also from Challenger St. 167 were labelled by Busk as *Caberea rostrata*, but they are characteristic specimens of *C. zelandica*.

The specimens from Tristan agree very closely with the type. The only differences detected are the slightly greater length of the pointed distal lobe of many of the scuta (Fig. 25 A), and the somewhat shorter mandible and correspondingly less prominent cell of the giant avicularia (cf. Fig. 25 A and B).

A specimen from New Zealand (St. TN 134), which otherwise resembles the type, has a little projection from the outer distal corner of the opesia which sometimes meets the scutum.

One of two young colonies from St. 1187 (Tristan, 18 November 1933) has developed far enough to show that it belongs to *C. rostrata*, and there are several young colonies from New Zealand (St. TN 134, 31 August 1911). The ancestrula and first zoecia are hardly to be distinguished from those of *C. darwinii*. Frontal avicularia appear sooner and are more conspicuous than in *C. darwinii*, and the scuta differ in shape. In *C. rostrata* the scuta on the first zoecia are less unlike those typical of the species and the transition to the normal form is completed by about the fifth zoecium.

The form recorded by Marcus as *C. rostrata* differs from Busk's species, see below.

The specimen from La Perouse, Sydney, attributed by Waters (1887) to *C. rostrata*, has been lent to me by the Manchester Museum. It has no giant avicularia, and the vibracula have a rather small chamber, leaving a great part of the basal surface of the zoecia uncovered. The groove is short and does not extend beyond the chamber. The setae are unfortunately all missing. The few complete scuta resemble those of *C. rostrata* in general shape but are a little larger, and the cryptocyst is narrow as in that species, but the specimen is clearly distinct from *C. rostrata*.

#### 9. *Caberea* sp.

*Caberea rostrata* Marcus, 1921 a, p. 95, text-fig. 1 a, b (not *C. rostrata* Busk).

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Juan Fernandez (Marcus).

Professor Marcus has kindly lent me a slide of the material from Juan Fernandez recorded by him (1921 a, p. 95) as *Caberea rostrata*, and I have also examined the unmounted material for which I am indebted to the Riksmuseum, Stockholm. It differs from typical *C. rostrata* in the shape of its giant frontal avicularia in which the chamber expands proximally, spreading over the base of the scutum of the neighbouring zoecium; in the scutum which has a larger blade with both the distal, and the proximal lobes rounded; and in having a slightly wider cryptocyst. The first two points are clearly shown in Marcus's figure, but the cryptocyst, as Prof. Marcus has himself pointed out to me, was not very accurately represented by his artist. I regard Marcus's form as distinct from *C. rostrata*. Comparison with *C. darwinii* (see p. 387 above) shows that it is also distinct from the forms of that species known to me.

## Synnotum Pieper, 1881

1. *Synnotum aegyptiacum* (Audouin).

*Loricaria aegyptiaca* Audouin, 1826, p. 243; Savigny, pl. xiii, figs. 4<sup>1</sup>-4<sup>5</sup>.

*Synnotum aegyptiacum* Harmer, 1926, p. 398, pl. xxvii, figs. 3, 4 (synonymy); Hastings, 1930, p. 702; 1932, p. 408; Marcus, 1937, p. 58, pl. xii, fig. 28 A, B; 1938a, p. 26, pl. v, fig. 12.

*Synnotum aviculare* Neviani, 1939, p. 20.

STATION DISTRIBUTION. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Pieper; Hincks; Waters; Calvet; Neviani); Red Sea (Waters); South Africa (Waters); Indian Ocean (Thornely; Robertson); Malay Archipelago (Harmer); Australia (MacGillivray; Waters; Hastings); New Zealand (Discovery); Japan (Ortmann); California (Robertson); Gorgona (Hastings); Curaçao; Tortugas (Osburn); Fernando Noronha (Kirkpatrick); Brazil (Marcus).

This species is represented by three small fragments only. They are, however, characteristic and prove that the species is, as might be expected, present in New Zealand waters.

## Farciminellum Harmer, 1926

1. *Farciminellum antarcticum* sp.n. Plate VIII; Figs. 26 B, 27 B.

*Farciminaria simplex* Livingstone, 1928, p. 24.

not *Farciminaria simplex* MacGillivray 1886a, p. 130, pl. i, fig. 1.

? *Farciminaria simplex* Kluge, 1914, p. 650, pl. xxviii, fig. 7; Harmer, 1926, p. 405.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 27, 42, 140, 144, 172, 175, 366, 1952, WS 42, Victoria Quadrant, Sts. 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia; South Sandwich Islands; South Shetland Islands (Discovery); Adelie Land (Livingstone); Wilhelm II Land? (Kluge); Oates Land (Terra Nova); Ross Sea (Terra Nova; Discovery).

HOLOTYPE. Australian Antarctic Expedition, St. 4, 65° 48' S, 137° 32' E, 230 fm. 30.2.24.1.

The Antarctic species, *Farciminaria simplex* Livingstone, differs in various ways from *F. simplex* MacGillivray, as noted by Harmer and Livingstone. I propose for it the name *Farciminellum antarcticum*. A specimen from the Australian Antarctic Expedition sent to me by Mr Livingstone agrees exactly with the Discovery and Terra Nova specimens, and I have made it the holotype.

*F. antarcticum* differs from *Farciminaria simplex* MacGillivray in its tendency to form flat pluriserial branches; in the greater length and slighter calcification of its zooecia; in the absence of the crenulation of the borders of the aperture; and in the presence of thin projecting edges to the aperture of the fertile zooecia (Fig. 26 B). The greatest difference is in the ovicells (cf. Fig. 26 A and B). In general appearance they are narrower and more prominent than those of *F. simplex*, and rather straight-sided. The ectooecium, which is continuous with the frontal membrane of the distal zooecium, is partly calcified, the calcareous portion forming a pair of plates or valves wrapping round the entooecium laterally and frontally. The valves meet in a median longitudinal suture which may form a slight keel. With light pressure the ovicell splits along this line as can be seen in one instance in Fig. 26 B. The entooecium may show a faint radial striation (Fig. 27 B).

The ovicell of *F. simplex* MacGillivray is immersed in a kenozoecium. The frontal wall of the kenozoecium, which forms the ectoecium, is wholly uncalcified and collapses into wrinkles on drying (Fig. 26 A), the space between the entoecium and the walls of the kenozoecium then forming the "depression" mentioned by MacGillivray. A longitudinal wrinkle may sometimes give the impression of a keel, but the ovicell is not keeled.

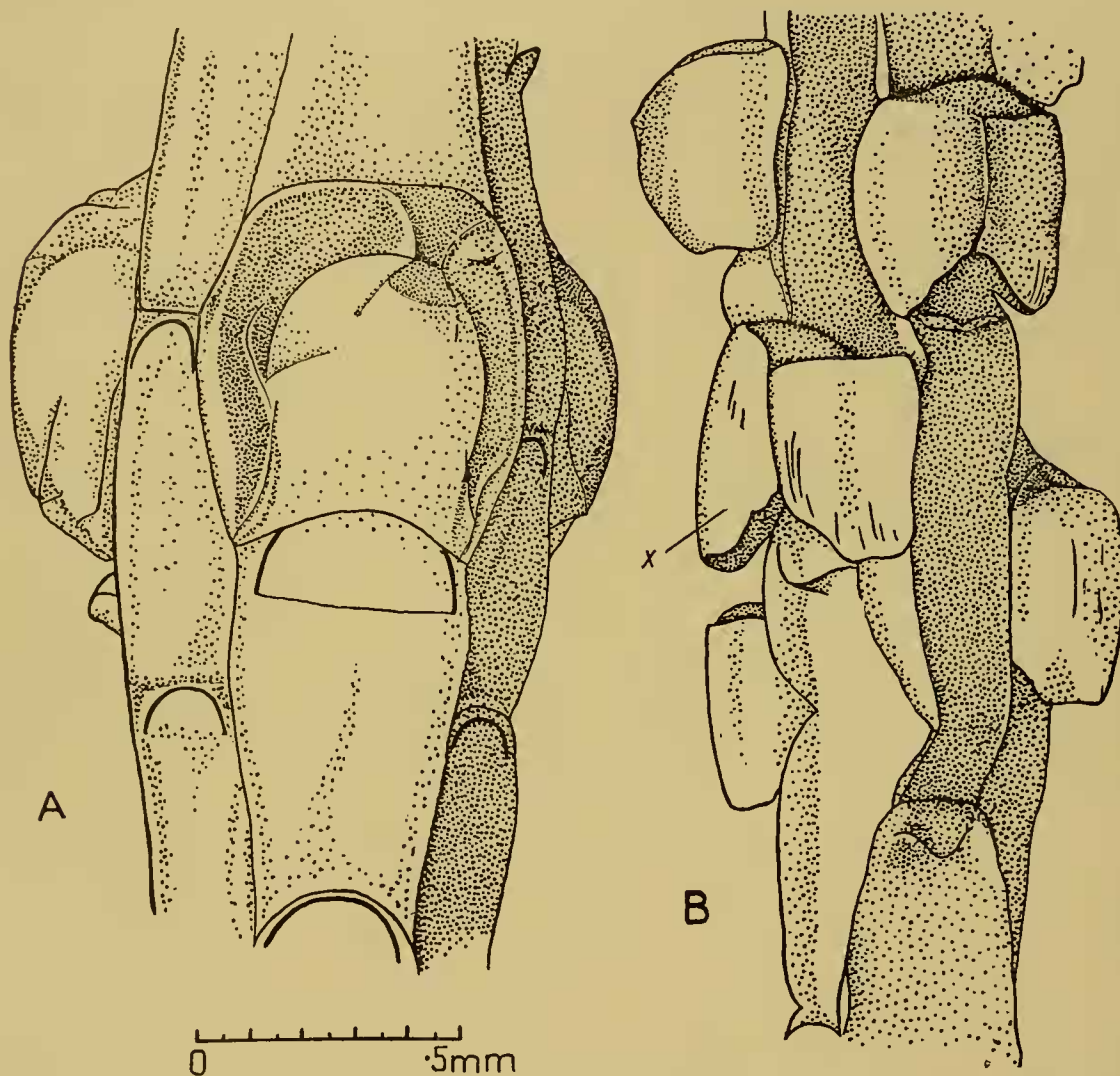


Fig. 26. A. *Farciminaria simplex* MacGillivray. 97.5.1.467. Port Phillip Heads. B. *Farciminellum antarcticum* sp.n. 30.2.24.1. Australian Antarctic Expedition, St. 4, off Adelie Land.

Both drawn from dry specimens seen by reflected light. X. slightly crushed ovicell showing splitting along median line.

This species has hitherto been known from more or less fragmentary material. The present specimens show that the colonies attain a considerable size. The material from St. TN 338 comprises six clumps. Plate VIII shows one of the smallest, the largest being 22 cm. long and profusely branched. The proximal branches are enveloped in a thick mass of rootlets so that the colonies appear to originate in a branching stalk.

The figured branch (Fig. 26 B) has four series of zooecia, but flattened, strap-like branches of varying width are more common. The broadest seen came from St. 1952 and had ten series of zooecia on each face. Both layers are formed of autozooecia. The absence of a layer of kenozooecia, and the structure of the ovicells may ultimately separate this species from *Farciminellum*.

Kluge (1914) introduced the name *Farciminaria simplex* independently. As pointed out by Livingstone, Kluge's species agrees with the present species in its zoaria, zooecia and locality. Unfortunately, its ovicells are unknown but it seems probable that *F. simplex* Kluge is a synonym of *Farciminellum antarcticum*.

## 2. *Farciminellum hexagonum* (Busk).

*Farciminaria hexagona* Busk, 1884, p. 51, pl. xiv, fig. 10, pl. xxxi, figs. 3-3*b*.

*Farciminellum hexagonum* Harmer, 1926, p. 405, pl. xviii, figs. 8-10, text-fig. 20 B (synonymy).

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Marion Island (Busk); Andaman Islands (Thornely); Malay Archipelago, 1224-3112 m. (Harmer).

## 3. *Farciminellum lineare* (Kluge).

*Flustra linearis* Kluge, 1914, p. 657, text-fig. 37.

*Farciminellum lineare* Harmer, 1926, p. 405.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Southern Ocean, 2910 m. (Kluge).

I have seen no specimen of this species.

## Levinsenella Harmer, 1926

### 1. *Levinsenella magna* (Busk).

*Farciminaria magna* Busk, 1884, p. 49, pl. v, fig. 1; Kluge, 1914, p. 650, pl. xxviii, fig. 8.

*Levinsenella magna* Harmer, 1926, p. 402 (synonymy); Hasenbank, 1932, p. 343.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Off East Africa, 1668 m. (Hasenbank); off Montevideo, 3477 and 4850 m. (Busk); Southern Ocean, 3065 m. and 3397 m. (Busk; Kluge).

I have compared Kluge's description with the type specimens and find that they correspond very closely. Busk's figures were drawn from the specimen from St. 325. The calcareous ribs described by Kluge are a conspicuous feature of the older zooecia. In the oldest zooecia at the base of the colony the whole aperture including the orifice is filled with coarsely granular longitudinal calcareous ridges. The rootlets from this part of the colony are also calcified.

As evidence that var. *armata* Busk is indistinguishable from the typical form Harmer mentioned the presence of single avicularia in two mounted specimens. They are quite numerous in parts of the unmounted colony (87.12.9.230) from which the two slides examined by Harmer were made.

The newly formed ovicells have a radially striated entoecium covered by a membranous ectoecium continuous with the frontal membrane of the distal zooecium. In older ovicells the entoecium is somewhat roughened, and calcareous plates, similar to those described in *Levinsenella borealis* by Levinsen (1909, p. 116, pl. i, fig. 12a-c, *cr*), form under the ovicell and curve round the distal part of the entoecium. In the specimen from St. 153 the ovicells are much flatter (narrower from frontal to basal surface) than in the type specimen from St. 325, and the calcareous plates meet in the mid-basal line. In the more convex ovicells from St. 325 the calcareous plates are only slightly developed and form a narrow strip at each side. There were no ovicells in Kluge's material.

*Kenella* Levinsen, 1909

1. *Kenella biseriata* (Busk).

*Flustra biseriata* Busk, 1884, p. 54, pl. xvi, fig. 1; Waters, 1896, p. 290, pl. viii, figs. 6-9, 22.

*Kenella biseriata* Levinsen, 1909, p. 124; Harmer, 1926, p. 249.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Off Valparaiso, 3953 m.; Malay Archipelago, 1509 m. (Busk).

This species shows marked resemblances to members of the Farciminariidae and I have therefore included the genus *Kenella*, of which *K. biseriata* is the genotype, in that family.

The curious lateral tubes described by Waters are the hydrothecae of a hydroid. Capt. A. K. Totton tells me that it is a species of *Reticularia*, probably *R. serpens*.

KEY TO THE GENERA OF BICELLARIELLIDAE DISCUSSED HERE

Definitions of these genera (except *Klugella* and *Erymophora* genn.n.) are given by Harmer (1926).

- |  |     |     |     |     |     |     |     |     |                    |
|--|-----|-----|-----|-----|-----|-----|-----|-----|--------------------|
| 1. Zoarium branching biserial or pluriserial   | ... | ... | ... | ... | ... | ... | ... | ... | 2                  |
| Zoarium uniserial and branching, or laminate and not branching   | ... | ... | ... | ... | ... | ... | ... | ... | 9                  |
| 2. Colony flustrine with short marginal kenozoecia   | ... | ... | ... | ... | ... | ... | ... | ... | <b>Klugella</b>    |
| Colony cellularine without marginal kenozoecia   | ... | ... | ... | ... | ... | ... | ... | ... | 3                  |
| 3. Colony stalked  | ... | ... | ... | ... | ... | ... | ... | ... | 4                  |
| Colony unstalked except in so far as rootlets surrounding proximal zooecia form a cable  | ... | ... | ... | ... | ... | ... | ... | ... | 5                  |
| 4. Stalk a cylindrical membranous peduncle with rootlets at tip, axillary zooecium ( <i>E</i> ) at bifurcation passing into branch of opposite side from that on which it originates |     |     |     |     |     |     |     |     | <b>Kinetoskias</b> |
| Stalk composed of a series of kenozoecia, axillary zooecium ( <i>E</i> ) at bifurcation passing into branch of side on which it originates   | ... | ... | ... | ... | ... | ... | ... | ... | <b>Caulibugula</b> |
| 5. Zoarium biserial. Zooecia divided into two or three sections by folds, <sup>1</sup> turbinate with relatively short opesia  | ... | ... | ... | ... | ... | ... | ... | ... | 6                  |
| Zoarium biserial or pluriserial. Zooecia not divided into sections, not turbinate. Opesia relatively long...   | ... | ... | ... | ... | ... | ... | ... | ... | 7                  |

<sup>1</sup> These folds or nicks in the walls of the zooecia are sometimes called joints, but are quite distinct not only from the highly developed joints of many of the Scrupocellariidae but also from the flexible joint-like zones developed in a few of the Bicellariellidae, e.g. *Bugula mollis* Harmer (1926, p. 445).

- 6. Avicularia of typical bird's-head form. Zoecia in three sections ... .. Bicelliariella
- Avicularia not of bird's-head form (often columnar or trumpet-shaped). Zoecia in two sections ... .. Cornucopina
- 7. Zoecia not forked proximally, connecting-process at bifurcation forming an axillary chamber, some at least, of the avicularia<sup>1</sup> with very long stalks ... .. Camptoplites
- Zoecia forked proximally, no axillary chambers formed, avicularia not long-stalked... .. 8
- 8. Avicularia<sup>1</sup> of bird's-head form. Operculum without distinct rim ... .. Bugula
- Avicularia<sup>1</sup> not of bird's-head form. Operculum with distinct chitinous rim ... .. Himantozoum
- 9. Zoarium uniserial with longitudinal connecting tubes at bifurcation ... .. Erymophora
- Zoarium laminate and fenestrate, the zoecia connected by four or six radiating tubes; or uniserial without longitudinal connecting tubes ... .. Beania

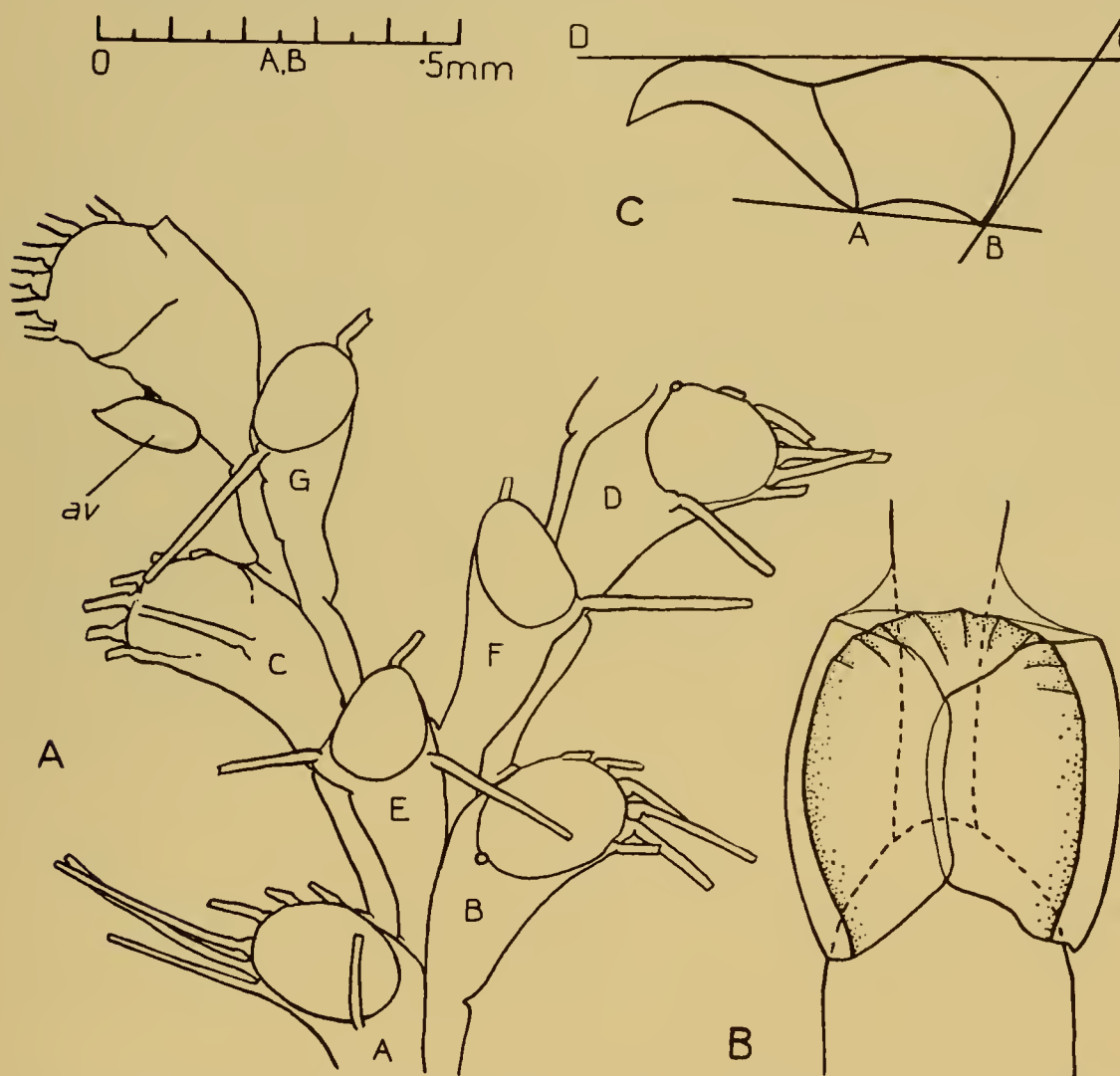


Fig. 27. A. *Bicelliariella* sp. St. WS 776, Patagonian Shelf. Zoecia at bifurcation lettered according to Harmer's scheme. B. *Farciminellum antarcticum* sp.n. St. WS 42, South Georgia. Ovicell. C. Diagram to illustrate upper and lower head-angles of avicularia.

av. avicularium.

<sup>1</sup> Avicularia are absent in a few species, e.g. *Camptoplites atlanticus*, *Bugula neritina*, *Bugula longissima* and *Himantozoum antarcticum*.

AVICULARIAN ANGLES. I have previously (Hastings, 1939, p. 332, text-figs. 275 B, C; p. 336, text-figs. 276 B, C) used Kluge's method of comparing the shapes of the heads of stalked avicularia by means of their upper and lower head-angles, but a definition of the terms may be useful here. In Fig. 27 C the lines *AB*, *BC*, *CD* form the upper and lower head-angles (*BCD* and *ABC* respectively) of the avicularia, as these terms are used by Kluge. It will be seen that the direction of *AB* is determined by the positions of two structural points (*A* and *B*), that *BC* is the tangent at *B* to the curve of the head, and that *CD* is the tangent common to the curves of the top of the head and the top of the beak. Where the tops of the head and beak form one continuous curve, with no intervening concave or flat portion, only the lower head-angle can be defined.

#### Bicellariella Levinsen, 1909

##### 1. *Bicellariella* sp. Fig. 27 A.

STATION DISTRIBUTION. *Sub-Antarctic*: Sub-Antarctic Ocean, St. WS 776.

GEOGRAPHICAL DISTRIBUTION. Patagonian Shelf (Discovery).

A single fragment of a species of *Bicellariella* from St. WS 776 is worth recording, as the genus is not otherwise known from the Falkland region.

In the shape of its rather long zooecia, the large size of its avicularia, and their position on the third, or distal, section of the zooecium, it may be compared to *B. capensis* (O'Donoghue, 1924, p. 32) which is probably synonymous with *B. chuakensis* (Waters, 1913, p. 467, see Harmer, 1926, p. 421 footnote). Its spines are more numerous than those of *B. chuakensis*; most zooecia having six in the distal series, and one being constantly present on the proximal border of the opesia (Fig. 27 A). The symmetrical, median, zooecium, *E*, at the bifurcation has three spines, one median distal, and one on each side of the proximal end of the opesia, turning outwards. The axillary zooecia *F* and *G* are smaller than the rest and have only two spines, one distal and one proximal. The bifurcation is of the type described by Harmer (1926, p. 421) in *B. levinseni*. The avicularium has a smooth beak, unlike that of *B. chuakensis* in which it is serrated (Waters, pl. lxxviii, fig. 7).

#### Cornucopina Levinsen, 1909

##### Key to the species of *Cornucopina* discussed here

- |   |                            |
|---|----------------------------|
| 1. Long, straight, flexibly attached, trumpet-shaped avicularia present ... ..      | 2                          |
| Avicularia all relatively short and either rigidly attached or curved ... ..        | 6                          |
| 2. Outer distal corner extended forming a spine-bearing process ... ..              | 9. <i>C. moluccensis</i>   |
| No spine-bearing process ... ..   | 3                          |
| 3. Ovicells borne on small adventitious zooecia ... ..                              | 4                          |
| No special ovicell-bearing zooecia ... ..   | 5                          |
| 4. Ovicells reduced. Stalked basal avicularia <sup>1</sup> gigantic and rare ... .. | 4. <i>C. polymorpha</i>    |
| Ovicells not reduced. Stalked basal avicularia small and common ... ..              | 3. <i>C. infundibulata</i> |

<sup>1</sup> For description of stalked basal avicularium see p. 399. It is to be distinguished from the straight trumpet-shaped type.



- |  |     |                         |                        |
|--|-----|-------------------------|------------------------|
| 5. Projecting part of zoecium narrow proximally, with a long tubular part and short opesia, ovicells very shallow, trumpet-shaped avicularia without bulbous swelling proximally | ... | ...                     | 2. <i>C. conica</i>    |
| Projecting part of zoecium broad proximally, with opesia occupying nearly its whole length, ovicells well rounded, trumpet-shaped, avicularia with bulbous swelling proximally   | ... | 1. <i>C. pectogemma</i> |                        |
| 6. Outer distal corner forming a spine-bearing process   | ... | ...                     | 7                      |
| No spine-bearing process   | ... | ...                     | 8                      |
| 7. Spines fairly evenly distributed on spine-bearing process, opesia angular and extending towards base of daughter-zoecium, cryptocyst present                                  | ... | ...                     | 10. <i>C. angulata</i> |
| Two or three spines at tip of spine-bearing process and two others unevenly spaced along it, opesia oval, not extending towards daughter-zoecium, cryptocyst absent              | ... | 11. <i>C. rotundata</i> |                        |
| 8. Cryptocyst present, avicularia attached rigidly   | ... | ...                     | 9                      |
| Cryptocyst absent, avicularia attached flexibly  | ... | ...                     | 5. <i>C. lata</i>      |
| 9. Aperture oval, turned almost at right angles to axis of branch  | ... | ...                     | 6. <i>C. ovalis</i>    |
| Aperture more or less triangular, not turned from axis   | ... | ...                     | 8. <i>C. zelandica</i> |

1. *Cornucopina pectogemma* (Goldstein). Figs. 28 C, 32 C.

*Bicellaria pectogemma* Goldstein, 1882, p. 42, pl. i, figs. 2, 2 A; Busk, 1884, p. 33, pl. vii, fig. 1; Kluge, 1914, p. 637.

*Cornucopina pectogemma* Harmer, 1926, p. 422; Hasenbank, 1932, p. 338, text-fig. 12 A-D.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, St. 6. *Antarctic*: Weddell Quadrant, Sts. 42, 175, 363, WS 27, WS 33, WS 42.

GEOGRAPHICAL DISTRIBUTION. Tristan da Cunha (Discovery); Marion Island (Goldstein); Prince Edward Island; Heard Island (Busk); Bouvet Island (Hasenbank); South Georgia; South Sandwich Islands; South Shetland Islands (Discovery); Wilhelm II Land (Kluge); Oates Land; Ross Sea (Terra Nova).

Kluge and Hasenbank both refer to the widening of the tube of the trumpet-shaped avicularium near its base (Hasenbank, text-fig. 12 C). This little bulbous swelling is constantly present in my specimens and in the type. A transverse septum is usually to be seen near the base of the bulb (Fig. 32 C). Hasenbank (text-fig. 13 A, D) showed a similar swelling at the base of an avicularium of *Cornucopina moluccensis*, but it is only occasionally present in that species, the constant feature being the eminence (Fig. 32 A) to which the avicularium is attached, which is absent in *C. pectogemma*.

The avicularia vary considerably within the colony, both in length and in size of head, but some colonies consistently show certain peculiarities. The avicularia are stouter and rather shorter, on the average, in that from the South Shetland Islands (St. 175); and conspicuously long and slender, though often large-headed, in the specimen from Tristan (St. 6). The specimen from the South Shetlands has shorter zoecia than most, with the distal part less divergent from the axis of the branch, but similar zoecia are also to be seen in one of the specimens from South Georgia (St. WS

27) whose avicularia have the more typical wide range of size. This South Georgian specimen has unusually numerous spines. In other colonies the maximum number is six (two close together on the outer corner of the zooecium, then three spread along the back, and one near the axis), but in the colony from St. WS 27 there are commonly six along the back, making a total of nine, fairly evenly spaced, spines. Other specimens from South Georgia have the typical number of spines, and zooecia of average length. Although a certain amount of variability is thus to be observed, the variation in the different structures does not seem to be correlated so as to present distinct forms.

Osburn (1940, p. 1) described *C. antillea* from 732 m. in the West Indian region. He noted that it differs from *C. pectogemma* in the form of the trumpet-shaped avicularia, in the presence of avicularia of a second type, in the number and distribution of the spines, and in the ovicells. As no mention is made of the bulbous swelling on the avicularium, this is presumably absent and constitutes a further difference. On the other hand the variation in the spines and trumpet-shaped avicularia in my material of *C. pectogemma* suggest that the differences in these structures may not be important. In particular some of the avicularia of the material from Tristan appear to be very similar to Osburn's. In the absence of figures, I am not clear what constitutes the difference in the ovicells. *C. antillea* thus seems to be chiefly distinguished by the presence of a second type of avicularium, by the absence of the bulbous swelling and by some undefined difference in the ovicells.

Two young colonies of *C. pectogemma* with ancestrulae were taken off Oates Land (St. TN 194). There are no avicularia but the more distal zooecia are otherwise characteristic. The proximal ones have more numerous spines, and differ from the corresponding members of the young colonies of *C. polymorpha* more in size than in shape. The ancestrulae have a small basal bulb which in the older specimen has formed a rootlet. The rest of the ancestrula is separated from the bulb by a joint, and consists of a very long and slender tube and an expanded part bearing the opesia and eleven or twelve evenly spaced spines. One rootlet has run down the back of the older colony and its swollen tip lies beside the bulb of the ancestrula which it somewhat resembles.

These ancestrulae differ from those of *C. polymorpha* described on p. 400 in their very much smaller bulbs and in the much longer tubular part (cf. Fig. 28 A and C). The septum, noticed in *C. polymorpha*, is indistinct but probably present. The shape of the bulb appears to be related to the substratum. The younger specimen (Fig. 28 C) is moulded to the lateral wall of a zooecium of *Himantozoum antarcticum* and is irregular in shape. The older one was found unattached. Its shape is more regularly oval.

## 2. *Cornucopina conica* Harmer.

*Cornucopina conica* Harmer, 1926, p. 428, pl. xxix, figs. 1-3.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Malay Archipelago, 924 m. and 1158 m.; off Crozet Islands, 2928 m. (Harmer).

3. *Cornucopina infundibulata* (Busk). Fig. 28 B.

*Bicellaria infundibulata* (part) Busk, 1884, p. 33, pl. vi, figs. 2, 2 *a-d*.

*Cornucopina infundibulata* Levinsen, 1909, pl. iv, fig. 4 *a-d*; Harmer, 1923, p. 306; 1926, p. 429.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. South Indian and Southern Oceans, 2516–3614 m. (Busk).

A specimen in the British Museum (90.4.14.4) comes from Challenger St. 146, a station from which no Polyzoa were described by Busk although their presence in the trawl is mentioned by Murray (1895, p. 448). Harmer discusses the relationship of this species to *C. polymorpha* and *C. conica* (see below, under *C. polymorpha*).

4. *Cornucopina polymorpha* (Kluge). Plate VII, fig. 3; Fig. 28 A, D.

*Bicellaria polymorpha* Kluge, 1914, p. 638, pl. xxx, fig. 1.

*Cornucopina polymorpha* Harmer, 1926, p. 422.

? *Bicellaria dubitata* Calvet, 1909, p. 5, pl. i, figs. 1, 2.

? *Cornucopina dubitata* Harmer, 1926, p. 422.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 148, 175, 181, 190, 366, WS 27, WS 33; Victoria Quadrant, Sts. 1652, 1658, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia (Discovery; Shackleton-Rowett Expedition); South Sandwich Islands; South Shetland Islands; Palmer Archipelago (Discovery); Bellingshausen Sea? (Calvet); Wilhelm II Land (Kluge); Oates Land; Ross Sea (Terra Nova; Discovery).

Among the small branches at his disposal Kluge did not find any which possessed gonozooecia together with both kinds of avicularia. His composite figure showing all these structures on a single branch is justified by the more abundant material collected by the 'Discovery'.

A few specimens have a third type of avicularium (Fig. 28 D). These, like the trumpet-shaped avicularia, are attached to the basal surface of the zooecia distally and near the middle of the branch. They are as long as the zooecia, or longer, and consist of a slender stalk, and a sharply demarcated head, which is about twice the length of the stalk. The beak is curved. The mandible is nearly as long as the head and is acutely pointed. In shape and position these avicularia resemble the basal ones of *Cornucopina infundibulata* but they are very much bigger (cf. Fig. 28 B and D), the beak is more hooked, and the stalk is more sharply marked off.

In most of the specimens in which this stalked type of avicularium was found the trumpet-shaped avicularia are exceptionally long, their length ranging from 2.2 to 4 mm., in contrast to the more typical 1–2 mm., but in the material from St. 1660 the stalked avicularia were found on branches some of whose trumpet-shaped avicularia measured as little as 1.2 mm. Other specimens with stalked avicularia came from St. 148 (South Georgia) and St. 366 (South Sandwich Islands). The longest trumpet-shaped avicularia were found in the colony from the Palmer Archipelago (St. 181).

*C. infundibulata* and *C. polymorpha* both have long trumpet-shaped avicularia attached to the basal surface more or less in line with the spines, but nearer the axis of the branch, and stalked basal avicularia placed close to the axis of the branch. The stalked

avicularia are small and common in *C. infundibulata*, gigantic and rare in *C. polymorpha*. In addition, *C. polymorpha* has the small curved frontal avicularia figured by Kluge. Harmer's comparison (1926, p. 429) is misleading because, the stalked avicularia of *C. polymorpha* not being known at the time, he contrasted the positions of the stalked avicularia of *C. infundibulata* and the frontal ones of *C. polymorpha*.

As can be seen from Plate VII, fig. 3, *C. polymorpha* grows luxuriantly. The photographed colony, which is the larger of two from the same station, is 13 cm. long, and when held up by the roots forms a mass more or less circular in transverse section and 7 cm. in diameter. Both these colonies terminate basally in a tangle of rootlets, with small stones and grit.

A complete young colony of *Cornucopina* found among the material of *C. polymorpha* from St. 175 (Bransfield Strait, 2 March 1927) has neither avicularia nor ovicells, but agrees well with that species in the shape of its zooecia, and in the number of spines on the more distal ones, those formed first having, as usual, more numerous spines. The colony was attached by a bulbous base fitting into the axil of the forked Cyclostomatous Polyzoan on which it was growing (Fig. 28 A). One end of the bulb is cut off by a curved, transverse septum. A bifurcate rootlet springs from this end of the bulb, and a short, rather thick-walled projection, originating just above the rootlet, gives rise to a long tube, expanding to a zooecial chamber, and separated from the projection by a joint like that separating the tubular and proximal parts of the other zooecia (cf. Harmer, 1926, p. 423). The tubular part of the ancestrula has a ring of thickening in its wall suggesting the beginning of another transverse septum. The expanded distal part resembles that of the other zooecia in shape, but has nine spines, evenly spaced in an obliquely transverse row. Successive zooecia have fewer spines, though they continue to be evenly spaced; and although the colony consists of forty zooecia it is only near the tips of the branches that the distinction between an outer group of spines and a single one near the middle line appears. Five zooecia have produced rootlets which, running down the basal surface and encircling the first zooecium, anchor the colony. A second young colony from the same station consists of a bulb and one zooecium only. These agree exactly with those already described, except that the zooecium has only eight spines.

The form described by Calvet from Biscoe Bay<sup>1</sup> as *C. dubitata* resembles *C. polymorpha* and *C. infundibulata* in having special ovicell-bearing zooecia, and in the presence of both trumpet-shaped and stalked basal avicularia. In the large size of the stalked ones, it resembles *C. polymorpha*, which is also the more probable geographically. Calvet suspected that his material had been decalcified in preservation, and one finds that decalcified specimens of *C. polymorpha* very closely resemble his figure. This might also account for the inflated appearance of the ovicell, which seems less reduced than that of *C. polymorpha*, though smaller than the well-developed hyperstomial ovicell of *C. infundibulata*.

<sup>1</sup> This must be in the neighbourhood of Biscoe Island, off Graham Land, which was the region visited by the expedition, not Biscoe Bay, King Edward VII Land.

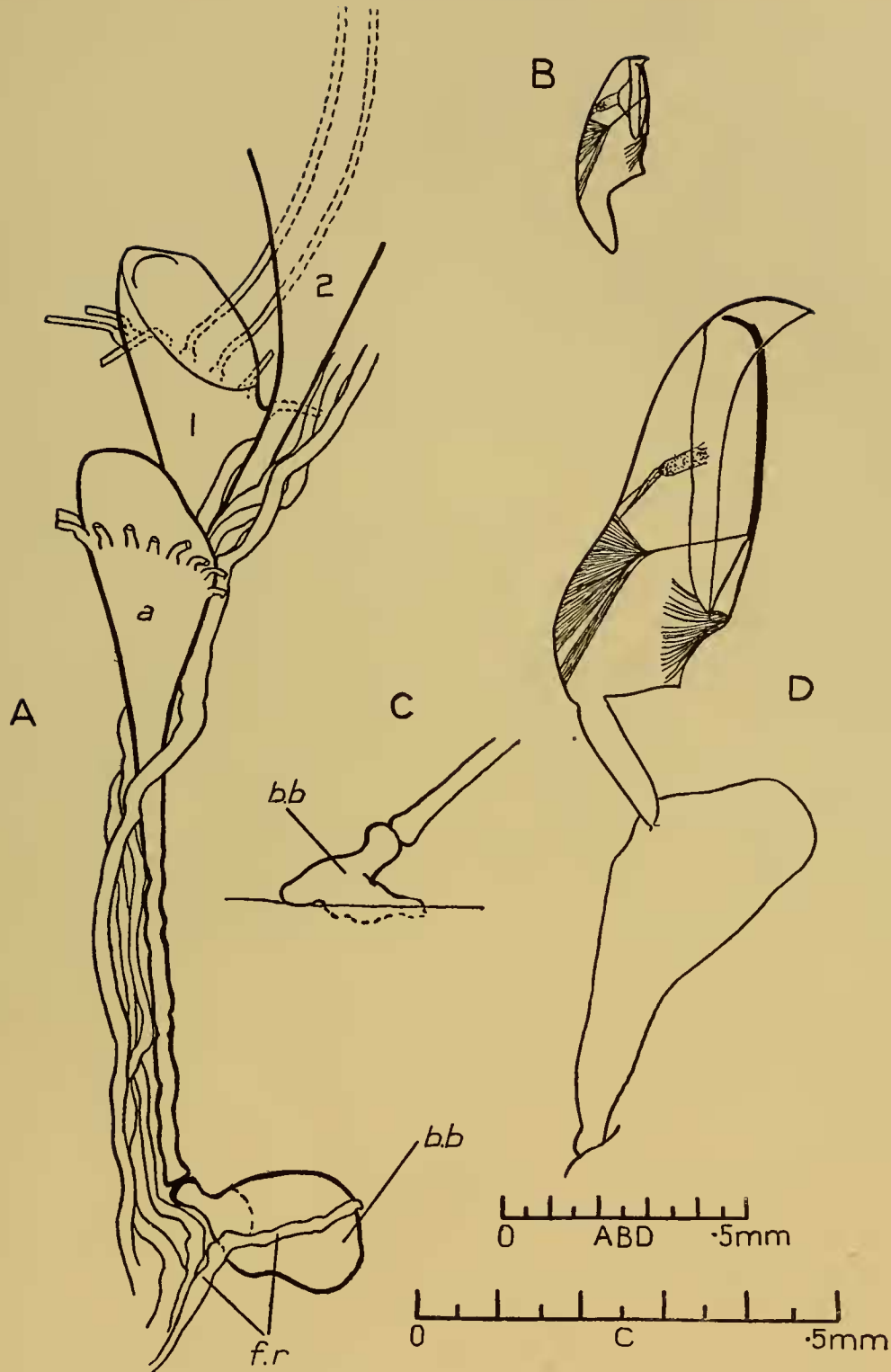


Fig. 28. A. *Cornucopina polymorpha* (Kluge). St. 175, South Shetland Islands. Ancestrula and first zooecium. B. *C. infundibulata* (Busk). Avicularium from Challenger St. 147, off Crozet Islands, 34.2.16.18. C. *C. pectogemma* (Goldstein). St. TN 194, off Oates Land. Basal bulb of ancestrula. D. *C. polymorpha* (Kluge). St. 181, Palmer Archipelago. Stalked basal avicularium with outline of zooecium to which it is attached.

a. ancestrula, b.b. basal bulb, f.r. forked rootlet originating from the basal bulb, 1-2, first two zooecia.

5. *Cornucopina lata* (Kluge).

*Bicellaria lata* Kluge, 1914, p. 639, pl. xxxiii, fig. 1.

*Cornucopina lata* Harmer, 1926, p. 422.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Wilhelm II Land (Kluge); Oates Land (Terra Nova).

In the Terra Nova material the broad tubular part of the projecting portion of the zooecium, between the main axis of the branch and the proximal border of the opesia, is usually longer than in Kluge's figure. In all other respects the agreement is very exact. The material is fragmentary.

6. *Cornucopina ovalis* sp.n. Plate VII, fig. 2; Fig. 29 A-C.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, St. 160.

GEOGRAPHICAL DISTRIBUTION. Shag Rocks (Discovery).

HOLOTYPE. St. 160.

DESCRIPTION. *Zoarium* bushy (type colony  $7.5 \times 7$  cm.) composed of delicate branches whose rootlets form a short thick stalk to the colony (Plate VII, fig. 2).

*Zooecia* without digitiform process, tubular part long, expanded part turned almost at right angles to the main axis (Fig. 29 A).

*Opesia* long, oval. Orifice at end of opesia farthest from middle of branch, oblique, being a little to outer side of long axis of the opesia. Other end of opesia occupied by a cryptocyst with irregular, more or less straight, edge.

*Spines*. Usually two on a common eminence at outer corner of zooecium, and a third close to them. Usually another spine near the middle of the branch and sometimes one in the intervening space making five in all.

*Basal avicularia* on many zooecia, originating near main axis of branch with mandible directed towards axis (Fig. 29 A, B), attached rigidly by fairly narrow base and widening relatively suddenly, but without any clear distinction of head and stalk, palatal surface oblique.

*Frontal avicularia* similar, less expanded distally (Fig. 29 C), mandible directed frontally, commonly present on fertile zooecia, rarely (if ever<sup>1</sup>) present elsewhere.

*Fertile zooecia* with four spines as in other zooecia, but with shorter, broader opesia (Fig. 29 A).

*Ovicell* large, longer than wide, with radially striated entoecium, connexion with distal zooecium as in other species of the genus.

REMARKS. This species resembles *Cornucopina grandis* (Busk, 1852*b*, p. 42) in the shape of its opesia and the possession of a cryptocyst, but all parts of the zooecia are more elongated. The basal avicularia are smaller, and, in the typical form but not in var. *versa*, face in a direction at right angles to those of *C. grandis* and have a more oblique palatal surface. In the typical form their outline follows the curvature of the main axis of the branch so that they appear neatly fitted into the angle between the projecting part of the zooecium and the main axis.

<sup>1</sup> Two fragments of a *Cornucopina* from the type-locality have frontal avicularia on non-fertile zooecia, but in the absence of basal avicularia and ovicells their identity is uncertain.

The fertile zoecia differ from the others in shape, having a shorter, rounder aperture. In *C. grandis* there is no such marked difference in the shape of the whole fertile zoecium, but the common base of the outer spines is rather long and stands beside the ovicell, following its curvature (Fig. 30 A). In *C. ovalis* these spines are basal to the ovicell and therefore hidden (except for their tips) in frontal view (Fig. 29 A), and their common base is not longer in fertile zoecia.

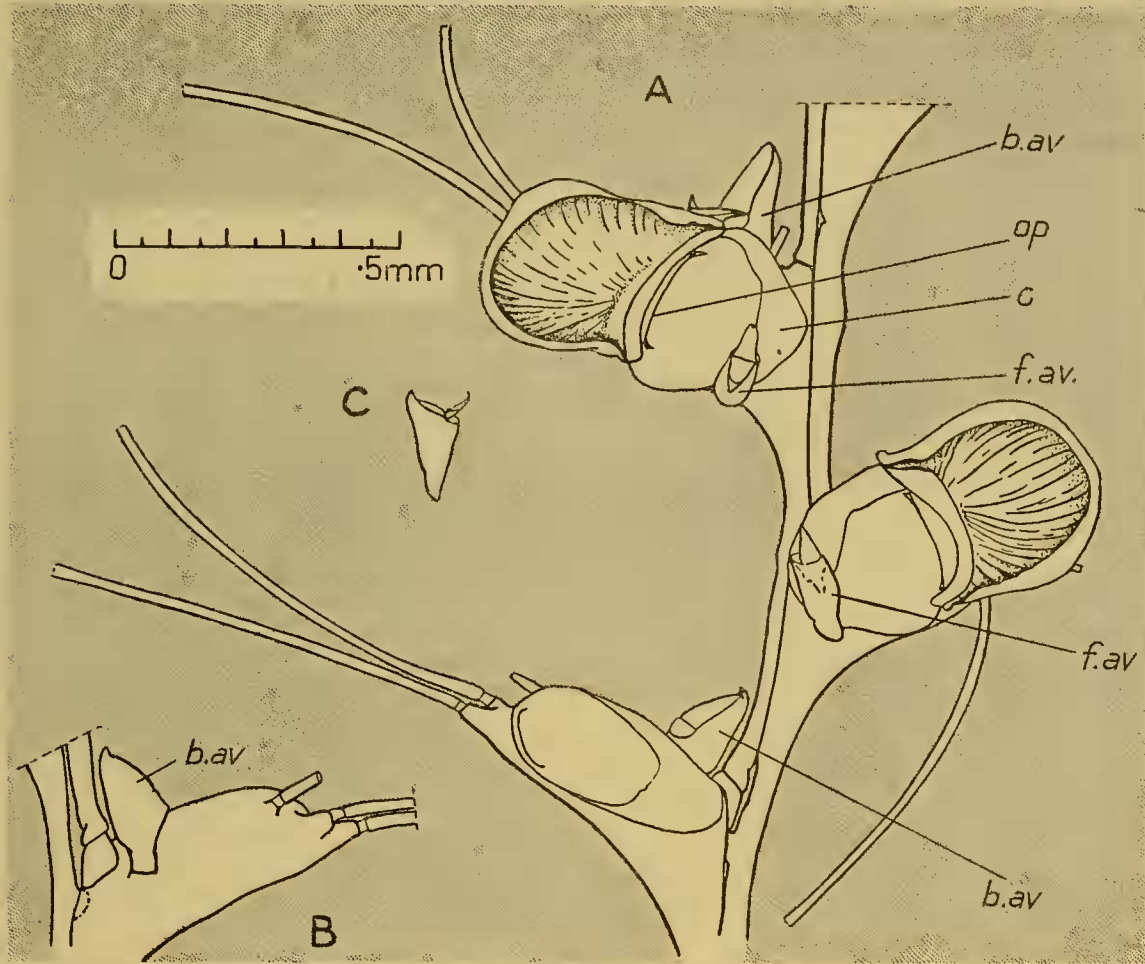


Fig. 29. A-C. *Cornucopina ovalis* sp.n. St. 160, Shag Rocks. A. Frontal view. One of the avicularia has a broken beak (dotted). B. Basal view of the non-fertile zoecium shown in Fig. A. C. Frontal avicularium in profile.

*b.av.* basal avicularium, *c.* cryptocyst, *f.av.* frontal avicularium, *op.* operculum.

It is clear from his figures that the specimen recorded as *Bicellaria grandis* by Waters (1904, p. 26) belonged to *Cornucopina ovalis* rather than to *C. grandis* (Busk). Unfortunately, Waters did not find avicularia or ovicells. His specimen came from the Straits of Magellan, but the depth is not recorded. As typical *C. ovalis* has only been found at the Shag Rocks, near South Georgia, and var. *versa* at the deeper Falkland stations (267-463 m.) and perhaps at Kerguelen, there is no geographical clue to the identity of Waters's form.

7. *Cornucopina ovalis* var. *versa* var.n. Fig. 30 B-D.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 228, WS 229, WS 246, WS 840, WS 871.

GEOGRAPHICAL DISTRIBUTION. Off Patagonian Shelf, below 200 m. (Discovery); Kerguelen? (34.2.16.44).

HOLOTYPE. St. WS 871, off Patagonian Shelf.

These specimens resemble the type specimen of *Cornucopina ovalis* in their zoecial characters, but differ in their avicularia. Ovicells are unknown. The basal avicularia

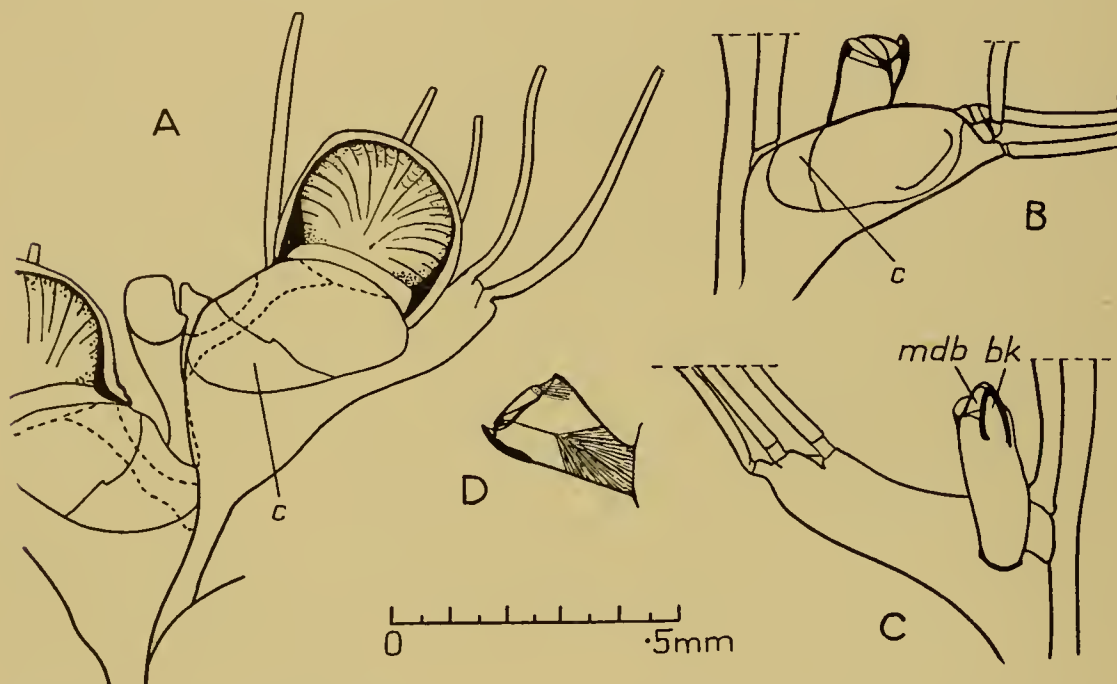


Fig. 30. A. *Cornucopina grandis* (Busk). 99.7.1.4541, Victoria (one of Goldstein's mounts) to show the relation of the spines to the ovicell for comparison with *C. ovalis*, Fig. 29 A. The connexion of the ovicells with the distal zooecia is shown by dotted lines. B-D. *C. ovalis* var. *versa* var.n. B, C. St. WS 871, off Patagonian Shelf. Frontal and basal views. D. St. WS 840, between Burdwood Bank and Patagonian Shelf. Basal avicularium as seen in a side view of the branch.

*bk.* beak, *c.* cryptocyst, *mdb.* mandible.

(Fig. 30 B-D) are rare. They are larger and stouter than those of the typical form, taper evenly, and project from the basal surface of the branch with the mandible directed basally (i.e. as in *C. grandis* and not as in typical *C. ovalis*). The palatal surface is terminal and transverse and the beak stout and prong-like. Frontal avicularia are commonly found on non-fertile zooecia and are usually much more numerous than in the typical form. They are a little larger than those of the typical form, but are not constantly different in shape.

The fragments from Sts. WS 228, WS 229 and WS 246 do not possess basal avicularia but are included in the variety rather than in the typical form on account of their locality. Frontal avicularia are present on some non-fertile zooecia. There are no



fertile zooecia. A similar small specimen found among unnamed material from Challenger St. 149 (Kerguelen) has also been tentatively attributed to the variety.

8. *Cornucopina zelandica* sp.n. Fig. 31 A-C.

STATION DISTRIBUTION. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Terra Nova, Sts. TN 90, TN 144; Discovery).

HOLOTYPE. St. TN 144.

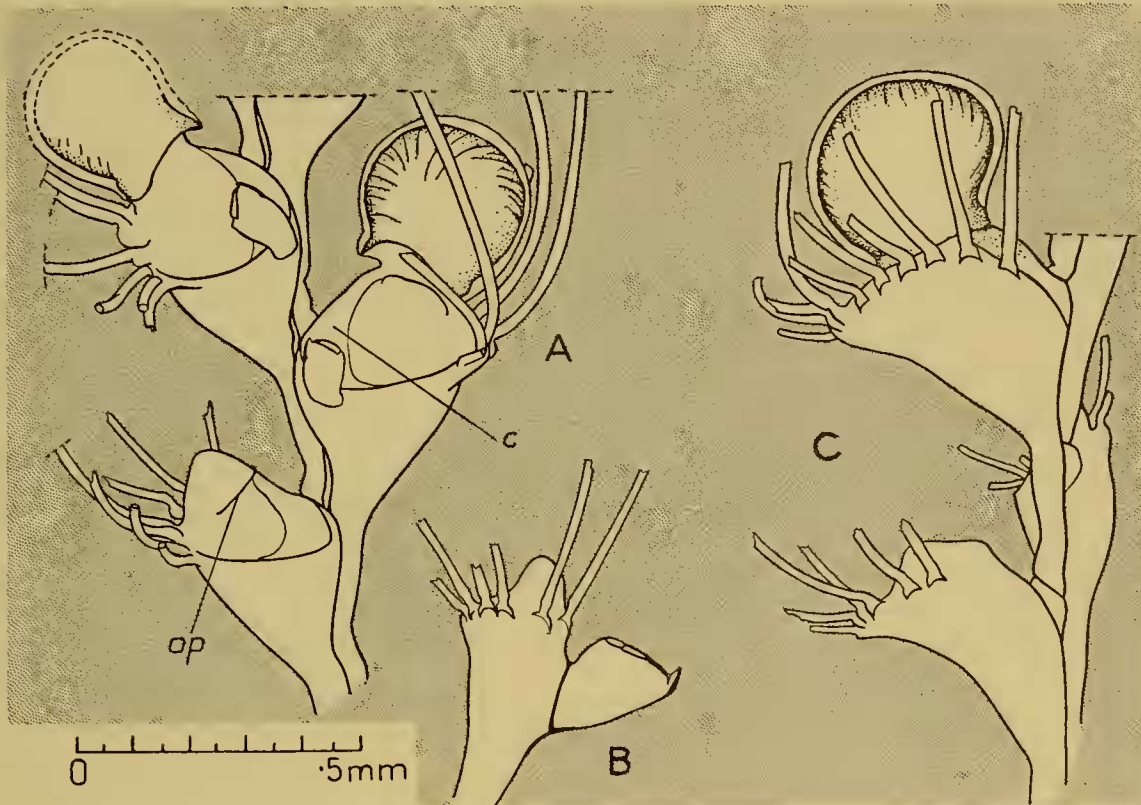


Fig. 31. A-C. *Cornucopina zelandica* sp.n. St. TN 144, New Zealand. A. Frontal view. B. Basal avicularium as seen in a side view of the branch. C. Oblique basal view.

*c.* cryptocyst, *op.* operculum (open).

**DESCRIPTION.** *Zoarium* bushy (type colony, 12 cm. high, 8 cm. broad) composed of very delicate feathery branches.

*Rootlets* forming a short, thick stalk.

*Zooecia* without a digitiform process.

*Opesia* short, broader than long, roughly triangular, proximal border straight, orifice at apex of triangle, outer basal angle of triangle occupying the prominent outer distal corner of zooecium. Inner basal angle with a curved cryptocyst (Fig. 31 A).

*Spines*, six or seven, four on distal corner, two or three in transverse row on basal surface.

*Fertile zooecia* a little broader than non-fertile, with eight to ten spines more evenly distributed in a transverse row (Fig. 31 C), recognizable by their shape, and by the

presence of a small ovary, before development of any trace of the ovicell which appears late.

*Ovicell* large, taller than wide, entoecium radially striated, the spines remaining intact behind ovicell. Connexion with distal zooecium as in other species of the genus.

*Avicularia* of two kinds, frontal and basal, both kinds unstalked and rigidly attached.

*Frontal avicularia* slightly curved and placed on the proximal border of the opesia (Fig. 31 A).

*Basal avicularia* larger, stouter, not curved, attached to the middle of the basal surface of the expanded part of a few zooecia, projecting outwards (Fig. 31 B).

REMARKS. This species appears to be related to *Cornucopina grandis* (Busk, 1852b, p. 42), which is also known from New Zealand. It differs from *C. grandis* in the shape of the opesia and its relation to the axis of the branch, in the narrower, more curved, unhooked cryptocyst (see Harmer, 1902, p. 290), in the more numerous spines and the absence of any trace of a spine-bearing process (cf. Figs. 30 A and 31 A), in the presence of frontal avicularia and the smaller size of the basal ones, and in the absence of any tendency for the tips of the branches to curl.

9. *Cornucopina moluccensis* (Busk). Fig. 32 A, B.

*Bicellaria moluccensis* Busk, 1884, p. 34, pl. vi, fig. 4.

*Cornucopina moluccensis* Harmer, 1926, pp. 422, 424, pl. xxix, figs. 7-10, 13-16 (synonymy); Hasenbank, 1932, p. 339, text-fig. 13 A-F.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Indian Ocean (Hasenbank); Malay Archipelago (Busk; Harmer); New Zealand (Terra Nova).

These specimens agree with *Cornucopina moluccensis* in the appearance of the colony and the general form of the zooecia. The spines have the same arrangement, and the avicularia are similar in position and form. Ovicells have not been found. The opesia extends to the end of the spine-bearing process, and there is a rather long cylindrical region between the tubular basal part of the zooecium and the opesia (Fig. 32 B). In these respects this material corresponds to Harmer's fig. 15. It differs from that figure, and from *C. moluccensis* in general, in the large size of the swelling of the proximal zooecium from which the daughter zooecium springs (Fig. 32 A, B) and in the shortness of the digitiform process. The avicularia are all of the long trumpet-shape with transverse mandible (Harmer, pl. xxix, fig. 7) and are variable in size.

10. *Cornucopina angulata* (Kluge).

*Bicellaria angulata* Kluge, 1914, p. 641, text-fig. 23.

*Cornucopina angulata* Harmer, 1926, p. 422.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Southern Ocean, 2450 m. (Kluge).

I have not seen a specimen of *Cornucopina angulata*. It may prove to be a synonym of *C. navicularis* Busk (1884, p. 32, pl. vii, fig. 2) from Challenger St. 122, a deep-water

station off Brazil. Busk's type specimen differs from Kluge's description in the presence of a small basal spine near the point of origin of the daughter-zooecium; in the frequent presence of a basal avicularium similar in shape to the frontal one, and placed about half way between the two single basal spines; and in the absence of a cryptocyst. It has large, fluted hyperstomial ovicells borne on zooecia which are rather larger than the non-fertile zooecia.

The specimen from Challenger St. 332, recorded by Busk as *C. navicularis*, agrees with *C. rotundata* (Kluge), and differs from the type of *C. navicularis* in its spine-bearing process which is longer with the spines less evenly distributed; in its opesia which is more oval in shape and does not extend towards the daughter-zooecium; and in the shape of the basal avicularium. There are no frontal avicularia and no ovicells.

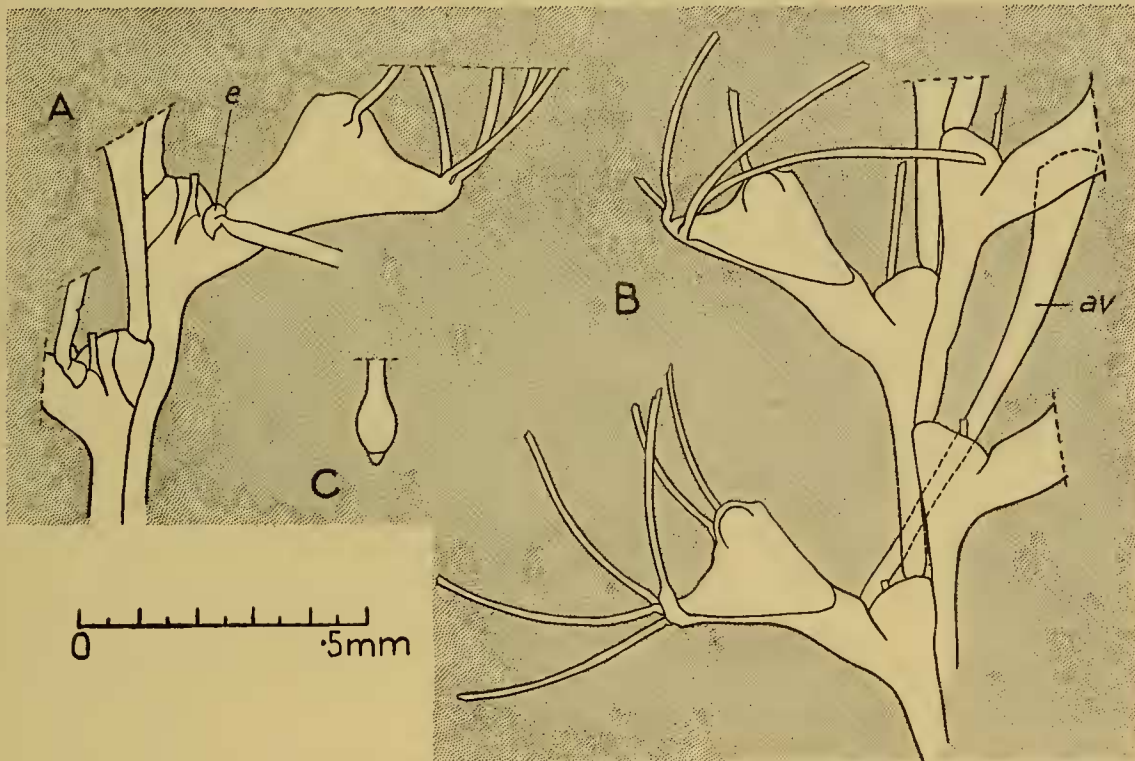


Fig. 32. A, B. *Cornucopina moluccensis* (Busk). St. TN 90, New Zealand. C. *C. pectogemma* (Goldstein). 87.12.9.157. Challenger St. 145, near Prince Edward Island. Base of avicularium, showing bulb and transverse septum.

av. avicularium, e. eminence to which avicularium is attached.

#### 11. *Cornucopina rotundata* (Kluge).

*Bicellaria rotundata* Kluge, 1914, p. 640, pl. xxxiii, fig. 2.

*Cornucopina rotundata* Harmer, 1926, p. 422.

*Bicellaria navicularis* (part) Busk, 1884, p. 32. [Specimen from St. 332.]

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. 35° 39' S, 50° 47' W. South Atlantic Ocean, 4026 m. (Busk); Southern Ocean, 3397 m. and 3423 m. (Kluge)

The specimen from Challenger St. 332 recorded by Busk as *Cornucopina navicularis* differs from the type-specimen of that species, see above, and closely agrees with *C. rotundata*, differing only in the absence of the small frontal avicularium, and in having two instead of three terminal spines on the spine-bearing process which, besides the two terminal spines, carries one spine at a short distance from the tip and a fourth spine part way between the third spine and the base of the process. As in Kluge's figure, there is also a spine on the basal surface of the zooecium near the point of origin of the spine-bearing process and another near the origin of the daughter-zooecium.

### Beania Johnston, 1840

#### Key to the species discussed here

- |  |                           |
|--|---------------------------|
| 1. Basal spines absent, avicularia typically present (absent in some specimens) ... ..   | 2                         |
| Basal spines present, avicularia absent ... ..   | 9                         |
| 2. Connecting tubes all at proximal end, greater part of zooecium erect ... ..   | 3                         |
| Connecting tubes distributed all round prostrate zooecium ... ..   | 5                         |
| 3. Six connecting tubes, not more than two distal spines... ..   | 4                         |
| Four connecting tubes, at least six distal spines ... ..   | 12. <i>B. scotti</i>      |
| 4. Zooecia small, a few marginal spines present, avicularia hump-backed, beak forming more than half their length, ovicell with tube passing to distal zooecium ... .. | 9. <i>B. challengeri</i>  |
| Zooecia large, no marginal spines, avicularia flat-backed, beak forming less than half their length, ovicell without tube ... ..                                       | 10. <i>B. erecta</i>      |
| 5. Six connecting tubes ... ..   | 6                         |
| Four connecting tubes ... ..   | 13. <i>B. intermedia</i>  |
| 6. Marginal spines absent ... ..   | 8. <i>B. magellanica</i>  |
| Marginal spines present ... ..   | 7                         |
| 7. Avicularia rare, single, passing between connecting tubes to basal surface ... ..   | 4. <i>B. inermis</i>      |
| Avicularia constantly present, frequently paired, not passing to basal surface ... ..  | 8                         |
| 8. Two horn-like processes on operculum, avicularia with short beak ... ..   | 1. <i>B. costata</i>      |
| No horn-like processes on operculum, avicularia with relatively long, but variable, beak ... ..  | 3. <i>B. discodermiae</i> |
| 9. Zooecia very long, recumbent, connected by six short, stout tubes, basal spines in single median line, branched ... ..  | 7. <i>B. pulchella</i>    |
| Zooecia not exceptionally long, erect, connected by four to six long, thin tubes, basal spines unbranched, scattered, chiefly towards periphery ... ..                 | 6. <i>B. fragilis</i>     |

#### 1. *Beania costata* (Busk).

*Diachoris costata* Busk, 1876, p. 116; 1879, p. 195, pl. x, figs. 4-6; Vallentin, 1924, p. 374.

*Beania costata* Kluge, 1914, p. 647, text-fig. 27 (references).

not *Beania costata* MacGillivray, 1886b (see *B. discodermiae*).

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 48, 56; South Indian Ocean, St. 1562.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region (Jullien; Calvet); Patagonian Shelf (Busk; Vallentin; U.S. National Museum; Discovery); Marion Island (Discovery); Kerguelen (Busk; Kluge).

This material agrees with Busk's descriptions and specimens. The pair of horn-like processes on the operculum described and figured by Jullien are constantly present. The gigantic avicularia mentioned by Hincks (1885) are present in several Falkland specimens.

A specimen collected at the Falkland Islands on 22 April 1927 (U.S. National Museum) has an ancestrula similar to that of *Beania costata* var. *maxilla* (see below).

Examination of specimens from Port Phillip Heads in the Bracebridge Wilson collection (97.5.1.383, 384, 386), identified as *B. costata* and agreeing very exactly with MacGillivray's description and figures, confirms Kluge's opinion that the Australian species is distinct. It appears to be very closely related to *B. discodermiae* (Ortmann) (see p. 410). The spines are rather numerous and there are usually two springing from the distal wall, behind the oral ones which are on the edge of the opesia. The avicularia are within the range of variation described by Harmer (1926, p. 415) but the very large ones are not present.

2. *Beania costata* var. *maxilla* (Jullien). Fig. 33 B, C.

*Diachoris maxilla* Jullien, 1888, p. 74, pl. vii, fig. 3, pl. xi, fig. 4.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, St. WS 85.

GEOGRAPHICAL DISTRIBUTION. Tierra del Fuego (Jullien); Falkland Islands (Discovery).

This form is so closely allied to *Beania costata* that I regard it as a variety. The chief difference is in the processes on the operculum, which are branched. They may appear irregularly stellate as in Jullien's figure (pl. xi, fig. 4), or the distally directed branch may be the most highly developed (Fig. 33 B, C). There are other differences of slight systematic value, namely, the presence of three (instead of two) pairs of erect distal spines, the shorter zooecia, and the smaller avicularia. Except on the ancestrula (Fig. 33 B) the spines in my material are longer than those figured by Jullien and resemble those of *B. costata*.

Some of the rootlets, like those of *B. inermis* and other species (see p. 411), have a branched tip and, as in *B. discodermiae* and *B. petiolata* (see Harmer, 1926, pp. 415, 416), a proximal lateral rootlet is sometimes present, in addition to the more distal median one.

The ancestrula (Fig. 33 B) is like the other zooecia in shape, but has shorter, more erect, spines. From the clearly defined flattened area on its basal surface one may deduce that it was encrusting. All the other zooecia have a curved basal surface which was clearly unattached.

Waters (1889, p. 4) gave this form as a synonym of *B. quadricornuta* (Hincks, 1885, p. 245), an Australian species. Hincks does not show any opercular processes, there are only four oral spines, and his figured zooecia, which are close together, do not become narrower in the region of the operculum as do those of the present specimen, and several of those figured by Jullien. In view of these differences, and of their wide geographical separation, and in the absence of undoubted specimens of *B. quadricornuta* for comparison, it seems best to treat them as distinct.

3. *Beania discodermiae* (Ortmann).

*Diachoseris discodermiae* Ortmann, 1889, p. 26, pl. i, fig. 23.

*Beania discodermiae* Harmer, 1926, p. 415, pl. xxviii, figs. 9, 10.

? *Beania costata* MacGillivray, 1886*b*, p. 68, pl. cxvii, figs. 3, 3*a*, 3*b* (not *B. costata* Busk).

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Japan (Ortmann); Malay Archipelago (Harmer); Victoria? (MacGillivray); New Zealand (Terra Nova).

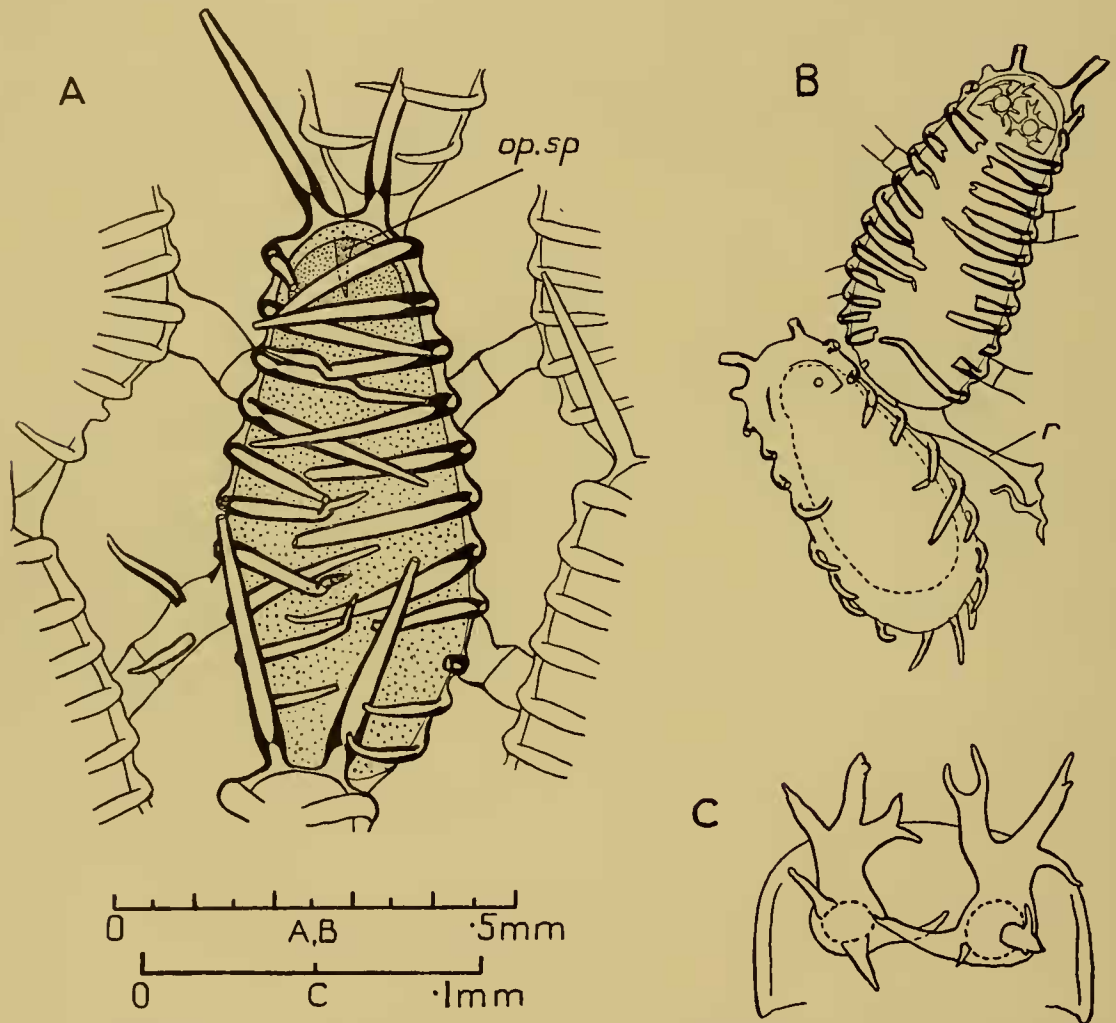


Fig. 33. A. *Beania inermis* var. *unicornis* var.n. St. WS 84, Falkland Islands. One zoecium with parts of adjacent zoecia sketched. B, C. *B. costata* var. *maxilla* (Jullien). St. WS 85, Falkland Islands. B. Ancestrula and one zoecium. The dotted line outlines the area of fixation of the ancestrula. The operculum of the ancestrula is incomplete. C. Operculum in frontal view.

*op.sp.* opercular spine, *r.* rootlet.

A fragmentary specimen in the Terra Nova collection agrees exactly with *Beania discodermiae* as described by Harmer. The reasons for regarding *B. costata* MacGillivray as a possible synonym of *B. discodermiae* are given on p. 409 above.

4. *Beania inermis* (Busk).

*Diachoris inermis* Busk, 1852*b*, p. 54; 1854, pl. lxxii, figs. 1, 2; 1879, p. 194; 1884, p. 60; Jullien, 1888, p. 73, pl. x, fig. 1; Kirchenpauer in Studer, 1889, p. 157.

*Beania inermis* O'Donoghue and de Watteville, 1935, p. 208.

*Diachoris hyadesi* Jullien, 1888, p. 74, pl. vii, figs. 1, 2.

*Beania hyadesia* Waters, 1904, p. 30, pl. i, fig. 7.

? *Beania hyadesi* Calvet, 1909, p. 13.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 85, WS 88.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region (Busk; Jullien; Waters); Patagonian Shelf (U.S. National Museum; Discovery); John Adams Bank, off Brazil (99.7.1.912, 926); South Africa (O'Donoghue and de Watteville); St Paul (Kirchenpauer); Kerguelen (Busk); Palmer Archipelago? (Calvet).

I have been unable to trace any specimen on which Busk might have based his record of this species from New Zealand (1852*b*, p. 54), and Hutton (1873, p. 94, asterisk explained on p. 1) listed it on Busk's authority without having seen specimens. I have myself seen no specimen from New Zealand.

From comparison of the original figures and descriptions, it appears that *Beania inermis* (Busk) and *B. hyadesi* (Jullien) differ in the number of spines, which, as Waters pointed out, might be due to the worn state of Busk's type specimen. The Discovery material confirms this suggestion, both conditions being found in a single partially worn colony from St. WS 85. Another colony from the same station, with the full complement of small acute spines, has avicularia and rootlets as described by Waters.<sup>1</sup> The presence of rootlets with branched tips is, however, not peculiar to this species. They have, for example, been observed in *B. hirtissima* (Heller), *B. fragilis* (Ridley) and *B. costata* var. *maxilla* (Jullien).

The avicularia, described by Waters as situated on a slightly raised chamber on the dorsal surface, prove to be stalked and attached to the border of the aperture just distally to the distal lateral connecting tube, as in several other species of *Beania*, but the stalk passes through the fenestra so that the avicularium projects on the basal surface of the colony. The large swollen head could not have passed through the fenestra, and the avicularium must have developed in this position. As usual in this genus the colonies were not encrusting, but fixed by rootlets. They were growing on the surface of other Polyzoa and as the rootlets were short the space between the colony and the substratum was very narrow. The presence of large avicularia in this space is rather surprising.

The specimens from the John Adams Bank, off Brazil, have avicularia in the basal position characteristic of the species, and, with their small and unevenly distributed spines, much resemble the type. Avicularia are absent in O'Donoghue and de Watteville's South African material (1936.4.2.7) and from the single piece from Kerguelen in the Challenger collection. Both specimens have irregularly distributed spines and

<sup>1</sup> Waters writes of the origin of the rootlet as proximal, but if the mandible points proximally, as in my specimens, the rootlets in his figure are distal.

resemble the type in general appearance. In the Kerguelen specimens from the Eaton collection, recorded by Busk (1879), the four distal spines are stouter than is usual, there are no lateral spines, and the connecting tubes are mostly not quite so short as in the typical specimens. A single rather compressed avicularium is present, projecting basally, and branched rootlets are numerous and extremely short. From the limited material available there seems no reason for separating this from *B. inermis*, especially as a specimen from Port William, Falkland Islands (U.S. National Museum), has exactly similar spines. This Falkland specimen has short connecting tubes, as in the type, and no avicularia.

Very shallow, cap-like ovicells are numerous in the Eaton Kerguelen material (see 99.7.1.918). The edges of the ectooecium and entoecium are seen in frontal view, and, owing to the shortness and distal position of the distal zooecial connecting tube, the ovicell makes contact with the distal zooecium without having a tubular prolongation such as is found in *B. magellanica*. The fertile zooecia contain large embryos.

Calvet did not make it clear whether the avicularia of his specimen appeared on the basal surface, and his comparison with *B. elongata* and *B. quadricornuta* suggests that they were in the more normal frontal position. The identity of his specimens is thus very uncertain, especially as this would be the only record of the species south of the Antarctic Convergence (see Table 3, p. 479).

5. *Beania inermis* var. *unicornis* var.n. Fig. 33 A.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 1321, WS 84, WS 85, WS 776.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region; Patagonian Shelf (Discovery).

HOLOTYPE. St. WS 84, Falkland Islands.

These specimens agree with typical *Beania inermis* in their avicularia. The marginal spines are longer and stouter, crossing over at their tips (Fig. 33 A). The oral spines consist of one pair of distal spines, as the next spine on each side, though it may be a little stouter than the other marginal spines, slopes inwards. The zooecia do not have the wavy outline usually seen in the typical form, and the connecting tubes are longer and may bear two or three spines, like the marginal spines of the zooecia. There is a spinous structure directed outwards and backwards from the middle of the free edge of the operculum.

These features give the colony a distinctly different appearance from that of typical *B. inermis*, and, in the material available, are constant and definite.

Branched rootlets are present.

In one specimen (St. 1321) a few of the connecting tubes are somewhat dilated and have an oval uncalcified frontal area surrounded by spines. Their appearance suggests abortive zooecia, and it may be that the otherwise normal tubes that bear two or three spines (Fig. 33 A) are more extreme examples of the same condition.

In some ways var. *unicornis* resembles *B. vanhoeffeni* Kluge (1914, p. 647), described from a specimen from Simons Bay, but in Kluge's species the distal marginal spine on each side is erect and much enlarged. These erect, stout spines are present in a specimen



from the Cape of Good Hope (92.3.16.6) which agrees very closely with Kluge's description and figure. *B. vanhoeffeni*, as represented by this specimen, also differs from var. *unicornis* in the absence of the spinous process on the operculum. It has no avicularia. Branched rootlets are present. *B. vanhoeffeni* is evidently nearly related to *B. inermis* but does not agree exactly with either the typical form or with var. *unicornis*.

*B. paucispinosa* O'Donoghue and de Watteville (1935, p. 208), which also came from South Africa, is probably identical with *B. vanhoeffeni*, as noted by Marcus (1937, p. 63). The erect distal pair of marginal spines is not so stout as in *B. vanhoeffeni*. Although the authors state that the method of interzooecial union is different from that of *B. inermis*, their description of the connecting tubes would apply equally well to *B. inermis*. The Discovery specimen compared by O'Donoghue and de Watteville with *B. paucispinosa* belongs to the present variety, specimens with avicularia not having been found at that time.

Okada and Mawatari (1938, p. 454) compared their Japanese species, *B. octaceras*, to *B. vanhoeffeni*. From their figure I should judge their species to be related to the Membraniporidae rather than to *Beania*. In many ways it resembles certain species of *Pyrulella* discussed by Hastings (1930, p. 710).

#### 6. *Beania fragilis* (Ridley).

*Chaunosia fragilis* Ridley, 1881, p. 45, pl. vi, fig. 1; Hincks, 1881b, p. 133.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 84, WS 85.

GEOGRAPHICAL DISTRIBUTION. Magellan Strait (Ridley); Falkland Islands (Discovery).

These specimens agree exactly with Ridley's type specimen. They differ from *Beania hirtissima* (Heller, 1867, p. 94) in the greater length of the zooecia and in their erect position. There may be four or six connecting tubes and they all spring from the extreme proximal end of the zooecium, giving an appearance of branched stolons, as shown by Ridley. In *B. hirtissima* there are six connecting tubes, and the anterior lateral pair springs from about the middle of the side of the zooecium, only the distal half of which is erect. The rootlet in *B. fragilis* originates at the point from which the connecting tubes radiate, which corresponds to the point of origin of the rootlet in *B. hirtissima*.

The spines of *B. fragilis* are numerous and long and, although two sometimes originate very close together, are unbranched as noticed by Ridley. The marginal spines over-arching the opesia are rather more slender and pointed than those which, as in the type, are scattered over the lateral and distal parts of the basal surface. Spines are rare on the central part of the basal surface.

The operculum is well chitinized. It has a thickened edge (shown white in Ridley's figure) bearing a blunt, median triangular process. It is quite distinctly marked off from the frontal membrane.

Despite Ridley's contrary statement, there is no gizzard.

7. *Beania pulchella* Livingstone.

*Beania pulchella* Livingstone, 1929, p. 56, pl. i, fig. 15, text-fig. 1.

STATION DISTRIBUTION. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Livingstone; Discovery).

The one small specimen of this species is without ovicells. On the whole it agrees very closely with Livingstone's description, but the spines of the outer series distinctly originate as branches from the bases of the spines of the inner series. The basal spine-bearing processes are arranged in a single row along the median longitudinal line of the zoecium. O'Donoghue and de Watteville (1935, p. 209) assumed from Livingstone's description, which is perhaps ambiguous on this point, that the zoecia are arranged in transverse rows in this species, but Livingstone's photograph and the present specimen both show the usual alternation in which each zoecium is connected with six others. The tubes are short and stout. The distal tube arises from the basal surface of the zoecium at some distance (two-thirds to one-half the length of the zoecium) from the distal end, and merges, without any recognizable point of transition from tube to zoecium, into the distal zoecium. Although the zoecia thus overlap each other considerably, they lie flat as in Livingstone's photograph. In *B. hirtissima*, where the distal tube also originates at some distance from the distal end of the zoecium, the free distal portions of the zoecia are more or less erect.

8. *Beania magellanica* (Busk). Figs. 34 C, 35 G.

*Diachoris magellanica* Busk, 1852*b*, p. 54, pl. lxxvii, figs. 1-3; Vallentin, 1924, p. 374.

*Beania magellanica* Harmer, 1926, p. 412, pl. xxviii, figs. 1-4, text-fig. 21 (references); Livingstone, 1929, p. 60; Hasenbank, 1932, p. 340, text-fig. 14 A-C; Livingstone, 1937, p. 379; Neviani, 1939, p. 18.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 58, 724, 1321, 1909, WS 81, WS 84, WS 85, WS 88, WS 93, WS 221, WS 225, WS 229, WS 231, WS 237, WS 243, WS 755, WS 784, WS 825, WS 838; South Indian Ocean, Sts. 1562, 1563, 1564.

GEOGRAPHICAL DISTRIBUTION. Mediterranean (Heller; Jullien; Waters; Harmer; Neviani; and others); Cape Verde Islands (Jullien; Calvet); John Adams Bank, off Brazil (99.7.1.4674); Magellanic Region (Jullien; Waters; Calvet; Discovery); Patagonian Shelf (Busk; Vallentin; U.S. National Museum; Discovery); off Patagonian Shelf, down to 240 m. (Discovery); South Africa (Jullien; Marcus; O'Donoghue; Hasenbank); Mauritius (Jullien); Marion Island; Prince Edward Island (Discovery); Kerguelen (Busk; Kluge); Australia (MacGillivray; Waters; Harmer; Livingstone); New Zealand (Waters; Livingstone); Auckland Island (01.12.26.33, Southern Cross Expedition); Japan (Jullien; Ortmann; Yanagi & Okada; Harmer).

Extensive sheets of this species were taken at Port Stanley, Falkland Islands (St. 56) on 19 May 1926, and in some pieces every zoecium is fertile. The fertile zoocia have a shoulder on each side of the ovicell, but have no distal spines. The presence of ovicells may account for the absence of spines in Hasenbank's fragment from South Africa.

Records of this species from New Zealand have sometimes been based on specimens of *Beania bilaminata* (Hincks). For example, those from Dr Lyell recorded by Busk (1852*b*, p. 54), and material sent to the British Museum by Hutton as *B. magellanica*

(75.1.5.75) both belong to Hincks's species. True *B. magellanica* is, however, found in New Zealand, for Waters (1906, pp. 14, 15) and Livingstone (1929, pp. 59, 60) both recognized the two species. The British Museum possesses a dozen specimens of *B. bilaminata*, all from New Zealand, one of which was figured by Hastings (1939, text-fig. 273 B, p. 328).

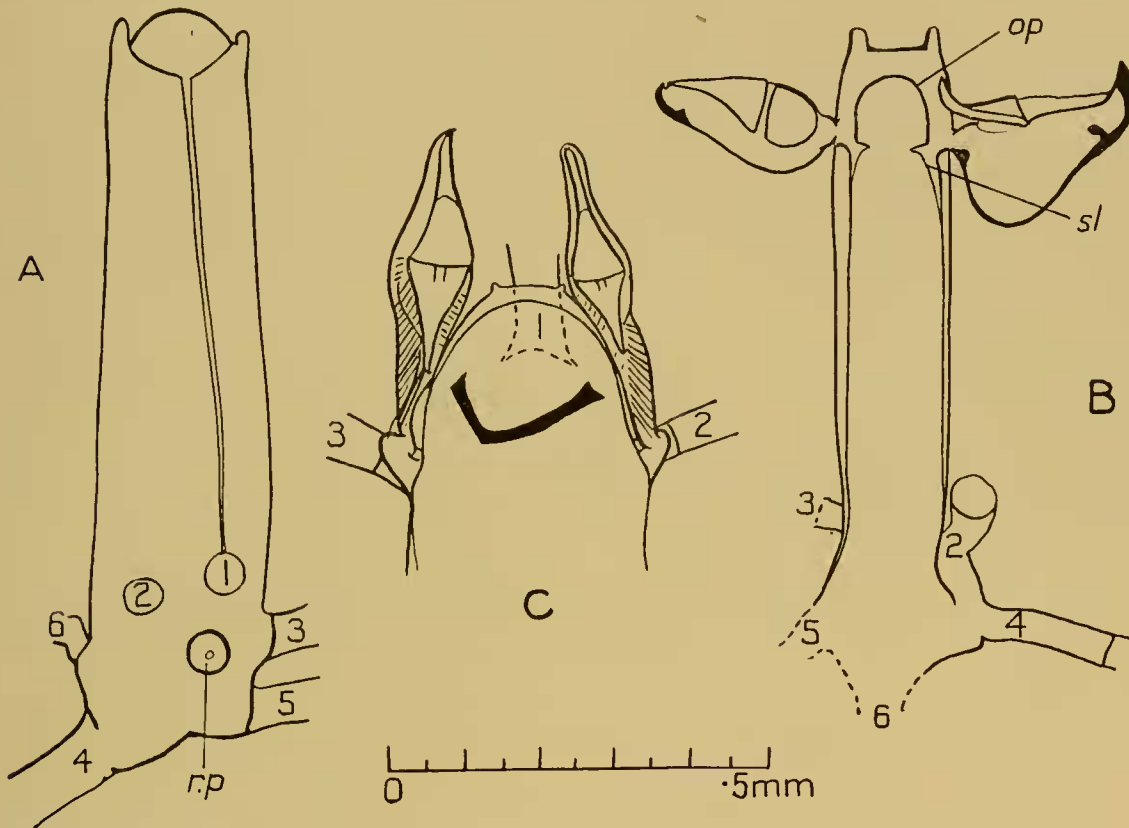


Fig. 34. A, B. *Beania challengerii* sp.n. 34.11.12.9. Challenger St. 149 D, Kerguelen. A. Basal view of fertile zoecium. B. Frontal view of a non-fertile zoecium. The proximal part was partly obscured by the next zoecium and is sketched with dotted lines. The distal connecting tube is also hidden. C. *Beania magellanica* (Busk). St. 1564, Prince Edward Island. Distal end of zoecium for comparison with Fig. B. The operculum is open.

*op.* operculum, *r.p.* rootlet-pore, *sl.* supposed sclerite in frontal membrane. The connecting tubes are numbered 1 distal, 2-5 lateral, 6 proximal.

9. *Beania challengerii* sp.n. Fig. 34 A, B.

*Beania magellanica* var. *distans*<sup>1</sup> Busk, 1884, p. 59, pl. xvi, figs. 2, 2 a.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Kerguelen (34.11.12.9); Heard Island (Busk).

HOLOTYPE. Challenger St. 149 D, Kerguelen, 34.11.12.9. This specimen was found among unnamed material in Busk's collection.

DESCRIPTION. *Zoecia* erect, straight-sided, rectangular distally, with a peg-like spine at each corner (Fig. 34 B). One small marginal spine (rarely two) frequently present on each side of distal half of opesia (absent in the figured zoecium).

<sup>1</sup> The varietal name is not available for the new species as it is preoccupied by *B. distans* Hincks (1881).

*Connecting tubes* six, arising near proximal end.

*Avicularia* stalked, attached at the level of the operculum, the beak forming more than half the total length, the muscle-chamber strongly humped dorsally.

*Ovicells* very shallow, connected with distal zoecium by tube extending whole length of basal surface of erect part of zoecium to meet remote distal connecting tube (Fig. 34 A).

REMARKS. Busk distinguished this form from typical *Beania magellanica* by the single phrase "zoecia widely distant". As can clearly be seen in his figure the difference lies not only in the length of the connecting tubes, but in their origin near the proximal end of an otherwise erect zoecium. In this the variety resembles *B. erecta*, but its zoecia and avicularia are very much smaller and differ in shape, and I have seen no trace of marginal spines in *B. erecta*, and no connexion between the ovicell and the distal zoecium.

Further differences from *B. magellanica* lie in the small size, straight sides and angular distal end of the zoecia (cf. Fig. 34 B and C); in the presence of marginal spines; and in the short, humped avicularia (cf. Figs. 34 B and 35 G). The only point of special resemblance to *B. magellanica* is the connexion of the ovicell with the distal zoecium. There is thus no adequate evidence that this form is specially related to either *B. magellanica* or *B. erecta*, and it seems best to treat it as a distinct species.

Busk's drawing represents a dried specimen in which the shrivelling of the soft parts has drawn the edges of the opesia together. Levinsen (1909, p. 100) was misled by this when he suggested that a new genus was represented.

10. *Beania erecta* Waters. Plate IX, fig. 2; Fig. 35 A, F.

*Beania erecta* Waters, 1904, p. 30, pl. i, fig. 8 a-e.

? *Beania erecta* Calvet, 1909, p. 13; Kluge, 1914, p. 649, text-fig. 29b.

not *Beania erecta* Livingstone, 1928, p. 26, pl. v, fig. 4; Hasenbank, 1932, p. 342, text-fig. 15.

? not *Beania erecta* Thornely, 1924, p. 7.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 160, 371; Victoria Quadrant, Sts. 1648, 1651, 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. Shag Rocks; South Sandwich Islands (Discovery); Bellingshausen Sea (Waters); Ross Sea (National Antarctic Expedition; Terra Nova; Discovery).

The Discovery material of *Beania erecta* comprises two distinct forms. One appears to agree with typical *B. erecta*, the other is described below as *B. erecta* var. *livingstonei*. Livingstone's figured specimens belonged to this variety, but where no figure of the zoecium (e.g. Kluge, 1914, p. 649) is given it is impossible to tell which form is recorded, though it is probable that Thornely, working on the same collection as Livingstone, based her record on the variety.

The ovicell of *B. erecta* is very shallow and flanked by the distal spines (Fig. 35 A). In frontal view its double edge can be seen. Basally it is oval in outline, the lateral walls continuing the line of the spines and meeting a transverse thickening of the basal wall. There is no tubular continuation such as is found in *B. magellanica*.

The rootlets arise from a short calcareous tube which projects from the recumbent part of the basal surface. It may arise not far from the centre of this area, projecting obliquely, but more frequently arises close to the distal connecting tube, pointing in the same direction as the tube. The rootlets may be very stout, though thin walled, and frequently ramify at the tips.

In the colonies from St. 160 (Shag Rocks) the zooecia are small and the connecting tubes unusually long (Plate IX, fig. 2).

In a small specimen from St. 1652 there is a zooecium without avicularia which, from its position with its back to all the other zooecia, i.e. with its frontal surface uncovered, and from the absence of any trace of the three proximal connecting tubes, appears to be the ancestrula. The next zooecium has a pair of avicularia which are placed more proximally than usual, being at about the middle of the length of the upright part of the zooecium. The ancestrula resembles the other zooecia in shape and has the two distal spines.

The specimen from the Agulhas Bank, attributed to this species by Hasenbank, differed from both the typical form and the variety in its very long and slender avicularia, in the absence of the two small distal spines, in its longer connecting tubes, and in the less proximal position of the three distal tubes. The shallow ovicell has a tube passing to the distal connecting tube as in *B. magellanica* and *B. challengerii*.

11. *Beania erecta* var. *livingstonei* var.n. Plate IX, fig. 1; Fig. 35 B, E.

*Beania erecta* Livingstone, 1928, p. 26, pl. v, fig. 4.

? *Beania erecta* Thornely, 1924, p. 7.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 42, 140, 159, 170, 175, 177, 190, WS 27.

GEOGRAPHICAL DISTRIBUTION. South Georgia (Discovery; Shackleton-Rowett Expedition); Elephant Island; South Shetland Islands; Palmer Archipelago (Discovery); Adelie Land (Livingstone); Ross Sea (Terra Nova).

HOLOTYPE. St. 159, South Georgia.

The whole distal end of the fertile zooecium of the variety is less blunt (cf. Fig. 35 A and B) and more markedly different from that of the non-fertile zooecium than in the typical form. Even at the low magnification of Plate IX, fig. 1, the distal ends of a few fertile zooecia, towards the middle and upper part of the figure, are distinguishable by their shape from the simply semicircular ends of the non-fertile zooecia. In both fertile and non-fertile zooecia the spines are nearer together than in typical *Beania erecta*, and the ovicell, which in both is shallow and fits between the spines, is thus correspondingly narrower. The distal border of the ovicell is more convex than in the typical form, and the lateral walls converge giving the ovicell a roundly triangular outline. The spines tend to lean towards the ovicell instead of pointing distally. The operculum has a distal protrusion which fits the more convex orifice of the ovicell, but, as the tip of the operculum curves inwards (i.e. towards the ovicell), this feature shows better in erect zooecia seen from above than in those mounted flat and seen in frontal view. It is recognizable in the marginal zooecia in Livingstone's pl. v, fig. 4, and shows that he had the variety.

The zoecia are rather larger and usually more hump-backed than those of the typical form.

The difference in the position of the avicularia is not always as marked as in the figured specimens. In shape, too, the avicularia of both the species and the variety are somewhat variable, and the distinction that appears in the figures is much less marked in other specimens.

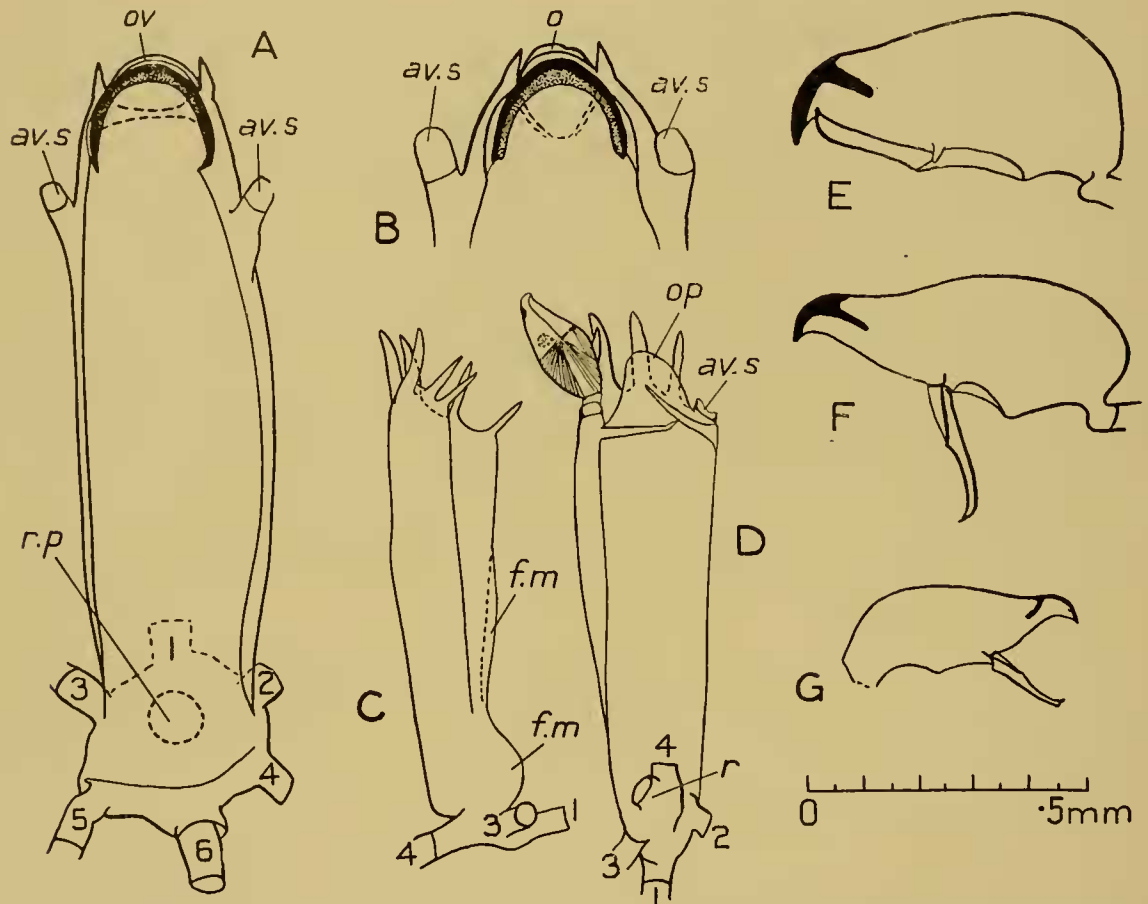


Fig. 35. A. *Beania erecta* Waters. St. 160, Shag Rocks. Fertile zoecium. The proximal connecting tube appears to have regenerated. B. *B. erecta* var. *livingstonei* var.n. St. 159, South Georgia. Distal end of fertile zoecium. C, D. *B. scotti* sp.n. St. TN 194, off Oates Land. In Fig. C the operculum was open and the remains of the tentacle-sheath everted, but these parts have been omitted from the drawing for clarity. The frontal membrane of this zoecium has sagged in preservation. E. *B. erecta* var. *livingstonei* var.n. St. 159, South Georgia. Avicularium. F. *B. erecta* Waters. St. 160, Shag Rocks. Avicularium. G. *B. magellanica* (Busk). St. 1564, Prince Edward Island. Avicularium.

*av.s.* avicularian stalk, *f.m.* frontal membrane, *op.* operculum, *o.* ovicell, *r.* supposed rootlet, *r.p.* rootlet-pore. The connecting tubes are numbered thus: in *B. erecta* (with 6), 1 distal, 2-5 lateral, 6 proximal; in *B. scotti* (with 4), 1 distal, 2-3 lateral, 4 proximal.

12. *Beania scotti* sp.n. Fig. 35 C, D.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Oates Land (St. TN 194).

HOLOTYPE. St. TN 194.

DESCRIPTION. *Zooecia* erect, straight-sided, tapering towards proximal end (Fig. 35 D). *Connecting tubes* four, arising very close together at proximal end.

*Avicularia* stalked, attached to distal border, between the two outer spines on each side, sometimes absent.

*Spines* all distal, prong-like, six on aviculiferous zooecia, the outer spine on each side bending over opesia, seven on zooecium without avicularia (Fig. 35 C), all directed distally.

*Ovicells* unknown.

REMARKS. Only three zooecia of this species of *Beania* have been found but they are so unlike those of any known species that I can only regard them as new in spite of the undesirability of describing species from scanty material.

*B. scotti* differs from *B. erecta* in the shape of the zooecia, the number and length of the distal prongs, and the shape and position of the avicularia. It appears also to differ in having four connecting tubes instead of six, though this point cannot be settled with certainty from this material as the tubes are not mounted in a convenient position.

A structure which appears to be the stump of a rootlet arises very near the proximal connecting tube in the zooecium shown in Fig. 35 D.

13. *Beania intermedia* (Hincks). Fig. 36 B.

*Diachoris intermedia* Hincks, 1881*b*, p. 133, pl. v, fig. 8.

*Beania intermedia* MacGillivray, 1890, p. 346, pl. cxcv, figs. 3, 3*a*; Waters, 1906, p. 15, pl. i, figs. 16-18. [Typical form.]

*Beania intermedia* Waters, 1909, p. 137; Osburn, 1914, p. 189; Kluge, 1914, p. 644, text-fig. 25; Hastings, 1927, p. 334; 1930, p. 705; Marcus, 1938*b*, p. 210, text-fig. 15. [Form without marginal spines.]

*Diachoris intermedia* Thornely, 1907, p. 184.

*Beania intermedia* Thornely, 1912, p. 142.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Tasmania (Hincks); Victoria (MacGillivray); New Zealand (Waters; Terra Nova); Chatham Island (Waters); Indian Ocean (Thornely); Red Sea (Waters); Suez Canal (Hastings); Cape Verde Islands (Kluge); Tortugas (Osburn); St Helena (Marcus); Gorgona (Hastings).

The Discovery specimen agrees very closely with *Beania intermedia* (Hincks). Hincks described one pair of marginal spines. My New Zealand specimens have one to three marginal spines on each side, in addition to a spine near the avicularium (Fig. 36 B). This short spine, just distal to the attachment of the avicularium, is rather constantly present in the New Zealand specimens and is shown in Hincks's and Waters's figures, where it appears to be the only spine in addition to the two or three distal ones. It is not shown in MacGillivray's figure in which there is a marginal spine on one or both sides proximal to the avicularium.

The specimens from the Red Sea (15.10.20.4), Suez Canal (26.9.6.134*c, d*) and Gorgona (29.4.26.248) differ from these typical specimens in their rather larger zooecia and in the complete absence of marginal spines. The avicularia, particularly of

the Gorgona specimen, are less humped dorsally and have a slightly longer beak. The figures show that the specimens from the Cape Verde Islands (Kluge), and St Helena (Marcus) also differ from the typical form in these respects. The specimens recorded by Osburn and Thornely were not figured and I have not seen them, but Osburn mentions that his material from the Tortugas was without marginal spines.

In *B. cupulariensis* (Osburn, 1914, p. 190; Harmer, 1926, p. 419), which shows some resemblance to *B. intermedia*, there is a much more complete series of marginal spines, and the last one on each side is usually directed outwards as in Osburn's fig. 7. The spine beside the avicularium is absent, and the connecting tubes are shorter than in *B. intermedia*.

#### *Klugella* gen.n.

GENOTYPE. *Flustra echinata* Kluge, 1914, p. 658, pl. xxxii, fig. 6, text-fig. 38.

DEFINITION. Colony flustrine consisting of broad, irregular lobes, with kenozoecia filling angles between marginal zooecia. Zooecia not forked proximally, or with a mere notch. Distal wall oblique with a group of uniporous septula. Lateral rosette-plates 1-4, in distal half of wall, multiporous. Opesia extensive. No cryptocyst. A small proximal gymnocyst. Avicularium jug-shaped, attached rigidly to proximal gymnocyst, with multiporous rosette plate at base. Rostrum directed transversely. Ovicells hyperstomial, entoecium calcified, ectoecium wholly or partly membranous. Avicularium not fused to ovicell.

REMARKS. The definition of this genus has been framed to include *Flustra crassa* Busk (1884, p. 53; see *Klugella buski*, p. 422) from Kerguelen, which resembles the genotype in its avicularia, and short, more or less spindle-shaped marginal kenozoecia, and in the general structure of its ovicells. It differs in the bilaminar colony and in the absence of any overlapping of the zooecia frontally. The indentation of the basal insertion of the proximal wall (Kluge, text-fig. 38c) which appears to be constant in *Klugella echinata* and presumably represents the forked proximal end of the zooecium of many other Bicellariellidae, is absent in *K. buski*. *K. buski* has less numerous rosette-plates, there being only one or two<sup>1</sup> in the distal half of each lateral wall, as compared with three or four in *K. echinata*. *K. buski* also differs in the absence of basal spines and (in the limited material available) of rootlets. Marginal spines are less developed in *K. buski*, but the two pairs of distal ones much resemble the two distal pairs of *K. echinata*. The mandible of the avicularium is shorter in *K. buski* although the spout-like beak is much alike in both species (see Fig. 36 C, Busk's figure being misleading). The ovicells of both species are essentially alike in structure, having a small area of attachment to the distal zooecium, a calcareous entoecium and an ectoecium of which the greater part, at least, is membranous. Those of *K. echinata* are more shallow and, as far as my experience goes, their only sculpture is a faint radial striation.

The boat-shaped zooecia of *K. echinata*, with their row of marginal spines, resemble those of various species of *Beania* and the basal spines are like those of *B. pulchella* (see

<sup>1</sup> Waters (1896, p. 284) says there are four (i.e. two in the distal half of the lateral wall) and figures one in the distal half. Both numbers are found in the type.



p. 414) and *B. nobilis* (see Hasenbank, 1932, text-fig. 10 B; Hastings, 1939, p. 327). *Klugella* differs from *Beania* in its interzooeccial connexions which are not tubular, in its avicularia, those of *Beania* being mobile and attached laterally, and in its marginal kenozooeccia.

*Dendrobeania* differs from *Klugella* in its stalked, mobile avicularia, in the absence of marginal kenozooeccia, and the presence of marginal zooeccia of distinctive shape, as in *Bugula*, *Bugularia*, etc.

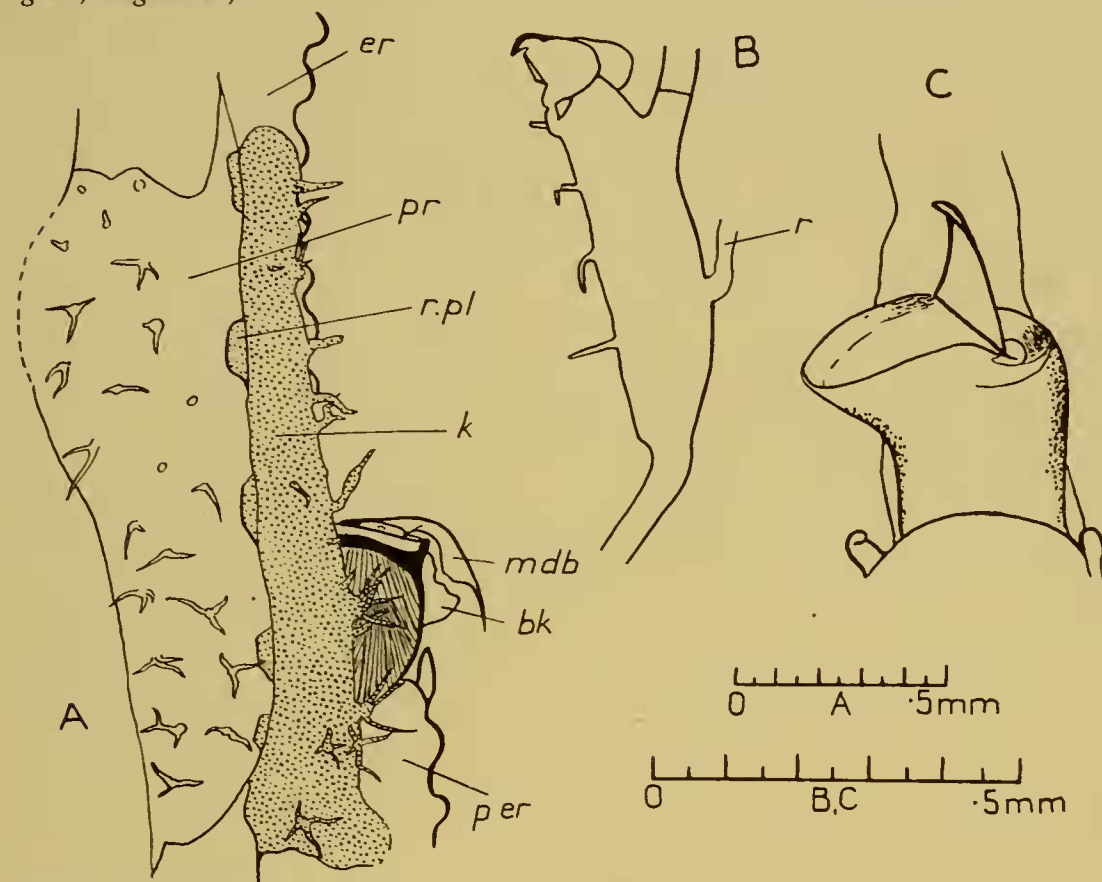


Fig. 36. A. *Klugella echinata* (Kluge). St. TN 316, McMurdo Sound. Basal view of margin of branch showing kenozooeccium (stippled). B. *Beania intermedia* Hincks. St. TN 134, New Zealand. One zooeccium in side view. C. *Klugella buski* nom.n. 87.12.9.252 A. Challenger St. 149 D. Kerguelen. Avicularium from the type-specimen with parts of adjoining zooeccia.

*bk.* beak, *er.* erect part of neighbouring zooeccium, *k.* kenozooeccium, *mdb.* mandible, *p.er.* erect part of proximal zooeccium, *pr.* proximal part of neighbouring zooeccium, *r.* rootlet, *r.pl.* rosette-plate.

*Klugella* seems to fit best into the Bicellariellidae as indicated by its resemblance to *Dendrobeania* and *Beania*, in spite of its possession of marginal kenozooeccia and, in the genotype, more numerous rosette-plates. Levinsen (1909, p. 122) transferred *K. buski* to the Bicellariellidae, but did not place it generically.

#### 1. *Klugella echinata* (Kluge). Fig. 36 A.

*Flustra echinata* Kluge, 1914, p. 658, pl. xxxii, fig. 6, text-fig. 38 a-c.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Wilhelm II Land (Kluge); Oates Land; Ross Sea (Terra Nova).

Kluge gave a full and accurate description of this species. The branches bear a marginal series of more or less spindle-shaped kenozoocia (Fig. 36 A), lying along the lateral walls of the marginal zoocia and connected with them by a series of rosette-plates which may be prominent as in the figured specimen. The kenozoocia have the effect of filling in the angles between the marginal zoocia which overlap them so that they are rarely visible in frontal view. The kenozoocia bear spinous processes like those on the basal surface of the ordinary zoocia.

Fig. 36 A shows part of the edge of a branch in basal view. The kenozoecium (stippled) lies along the lateral wall of the proximal part (*pr.*) of a marginal zoecium. The lateral wall of the erect distal part of this zoecium (*er.*) is to be seen beyond the distal end of the kenozoecium and the avicularium belonging to the same zoecium is visible beyond the kenozoecium marginally. The distal and proximal ends of the neighbouring zoocia in the longitudinal series are also visible.

## 2. *Klugella buski* nom.n. Fig. 36 C.

*Flustra crassa* Busk, 1884, p. 53, pl. xvi, figs. 6, 6 a, b (not *F. crassa* Desmarest and Lesueur, 1814, p. 53); Waters, 1896, pp. 281 *et seq.*, pl. i, fig. 22, pl. ii, fig. 5.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Kerguelen (Busk).

HOLOTYPE. Challenger St. 149 D, Kerguelen, 87.12.9.252 A, the holotype of *Flustra crassa* Busk.

The name *Flustra crassa* being preoccupied by *F. crassa* Desmarest and Lesueur I propose the trivial name *buski* for Busk's species which, as explained above, I propose to include in *Klugella*.

As shown by Waters (1896, pl. ii, fig. 5), and in my Fig. 36 C, the avicularium is columnar and attached by a broad base, and has a spout-like beak. Some, but not all, zoocia have the short conical spines on the distal corners, noticed by Busk, and some have in addition a pair of longer spines, placed one on each side, just proximal to the distal spine, and arching over the opesia. The hyperstomial ovicell is longer than wide, with a membranous ectooecium and a calcareous entoecium bearing reticulate sculpture reminiscent of that of *Camptoplites retiformis*. As already mentioned, the angles between the marginal zoocia are filled by more or less spindle-shaped kenozoocia.

## Himantozoum Harmer, 1923

### 1. *Himantozoum antarcticum* (Calvet). Fig. 37 B.

*Flustra antarctica* Calvet, 1909, p. 11, pl. i, figs. 4-6; Livingstone, 1928, p. 22, pl. iii, fig. 9 (references).

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 20, 27, 42, 45, 144, 164, 175, 190, 363, 456, 474, 1872, 1873, 1961, WS 27, WS 33, WS 42, WS 177; Victoria Quadrant, Sts. 1652, 1658, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia (Discovery; Shackleton-Rowett Expedition); Bouvet Island; South Sandwich Islands; South Orkney Islands; near Elephant Island (Discovery); South Shetland Islands (Discovery; 20.12.11.1, from 200 fm. on whale harpoon); Palmer Archipelago (Discovery; Calvet); Adelie Land (Livingstone); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (Terra Nova; Discovery).

The affinities of Calvet's species appear to be with the Bicellariellidae rather than the Flustridae. Of the described genera of the family it approaches most closely to *Himantozoom* Harmer (1923, p. 311; 1926, p. 453) with which it agrees in the form of the colony and zooecia, in the method of bifurcation and in the possession of a distinct operculum. It differs in the absence of avicularia and the presence of ovicells, but the ovicells are shallow and, as noticed by Calvet, only accommodate a small part of the embryo. The difference between *H. taurinum* with its internal ovisacs and *H. antarcticum* with shallow ovicells appears unimportant when one considers the great similarity of their zooecial and zoarial characters, especially as *H. sinuosum* and *H. obtusum* sp.n. have rudimentary ovicells of intermediate character.

In comprising species both with and without avicularia, and showing a graded series of ovicells *Himantozoom* would resemble other genera of the Bicellariellidae, particularly *Beania*. There is thus justification for modifying the definition of *Himantozoom*, in these ways. A list of the species that I include in *Himantozoom* is given in the legend to Fig. 63, p. 494.

*Bugula versicolor* Busk (1884, p. 38) is still excluded from *Himantozoom* by its large endozooecial ovicells, which are very different from the shallow hyperstomial ovicells of *H. antarcticum* and, as suggested by Harmer (1926, p. 454), may relate it to the Farciminariidae. Although they are immersed in autozooecia instead of kenozooecia, they have much in common with the ovicells of *Kenella biseriata* which should, in my opinion, be placed in the Farciminariidae (see p. 394).

There is some variation in the position of the spines on the fertile zooecia in *Himantozoom antarcticum*. They may be directed distally or obliquely inwards, but in this material they seldom have the almost transverse position shown in Calvet's figure. The fine colony from Bransfield Strait has branches with as many as eleven series of zooecia.

A young colony from St. 1660 (Ross Sea, 27 January 1936) consists of an ancestrula and seven zooecia arranged in a single series. The ancestrula is attached by its slightly expanded base, and both the ancestrula and the succeeding zooecia are typical in shape with the opesia occupying the greater part of the frontal surface and the distal corners pointed. Each zooecium gives rise to a rootlet proximally from the lateral wall, and these rootlets adhere to the basal surface of the colony. In six other young colonies from St. 1660, the number of zooecia in the basal uniserial portion of the colony varies from four to nine. The figured ancestrula (Fig. 37 B), which is exactly similar in shape to those from St. 1660, came from St. TN 194 (off Oates Land, 22 February 1911).

The "stalk", mentioned by Harmer (1923, p. 311), is formed by rootlets enveloping the zooecia of the more proximal parts of the colony, as described by Calvet. In some specimens these rootlets are calcified.

Since this report was in proof I have seen a paper by Braem (1940, p. 675) who finds that the alimentary canal of *Bugula apsteini*, which I have included in *Himantozoom*, shows the same peculiarities as the other forms of *Himantozoom* examined by him, namely<sup>1</sup>

<sup>1</sup> Braem examined material from the Deutschen Tiefsee Expedition. He does not mention varieties or forms, but according to Hasenbank (1932) the expedition did not obtain the typical forms of these two species. The question whether Hasenbank's material of *H. sinuosum* is distinct from the typical form is discussed below.

*H. sinuosum* (var. *variabilis*?) and *H. leontodon* forma *cornuta*. Braem suggested that the presence of hyperstomial ovicells in *Bugula apsteini* might nevertheless make it necessary to place it in a separate genus, but with my modification of the genus this difficulty does not arise.

I have examined the type-specimens of *H. mirabile* (87.12.9.182), *H. margaritiferum* (87.12.9.200) and *H. leontodon* (87.12.9.177). In all of these, and particularly the first two, the tentacles are very long and the other parts of the polypide are much reduced as described by Braem. No caecum is discernible in a whole mount and the pharynx is slender.

In *H. antarcticum* and *H. obtusum*, on the other hand, the gut is well developed and has a quite conspicuous caecum and a rotund pharynx. Braem described the peculiarities of his species in comparison with *Bugula neritina*. I have compared spirit-preserved specimens of *Himantozoum antarcticum* from St. 474 and of *Bugula neritina* from the Suez Canal (26.9.6.133f). These were decalcified and mounted whole, the *Himantozoum* being stained with borax carmine, the pigmentation of the *Bugula* sufficing without staining. Fully grown polypides in similar positions were compared, and no significant or constant difference in size, shape or proportion of parts was observed.

In the type-specimen of *H. sinuosum* (87.12.9.179) the whole polypide is longer and more slender than in *H. antarcticum*, the tentacles are relatively longer, and a caecum is not discernible, but the rest of the alimentary canal is quite well developed. *H. sinuosum*, which apparently ranges from 146 m. to 3397 m., is thus more or less intermediate between the abyssal forms and the two relatively shallow-water species, *H. antarcticum* and *H. sinuosum*.

## 2. *Himantozoum obtusum* sp.n. Fig. 37 A, C.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 85, WS 93, WS 225, WS 228, WS 229, WS 231, WS 246, WS 249, WS 783, WS 871.

GEOGRAPHICAL DISTRIBUTION. Patagonian Shelf (Discovery); off Patagonian Shelf down to 1098 m. (Discovery; 34.11.12.12 from Challenger St. 320).

HOLOTYPE. St. WS 228, off Patagonian Shelf.

DESCRIPTION. *Colony* usually bi- or triserial. Uniserial at base and occasionally quadriserial before a bifurcation. Bifurcation as in other species of *Himantozoum*.

*Rootlets* as in *H. antarcticum*.

*Zooecia* like those of *H. antarcticum* except that they are smaller and are rounded distally, without angles or spines (Fig. 37 A). "Tubulure" (of Calvet) present.

*Avicularia* absent.

*Ovicells* on median zooecia very shallow, without associated spines (Fig. 37 A, C). Embryo develops in large sac in body cavity.

REMARKS. This species, which is confined to the Patagonian region, is very similar to *H. antarcticum*. In addition to its more slender colony, and the differences already noted in the zooecia and ovicells, there appears to be a slight difference in the shape of the opercula, those of *H. antarcticum* being more angular, their shape corresponding to the shape of the distal end of the zooecium. In *H. obtusum* the opercula of the

fertile zooecia are a little longer and rounder than the others. The Challenger specimen was found among unnamed material.

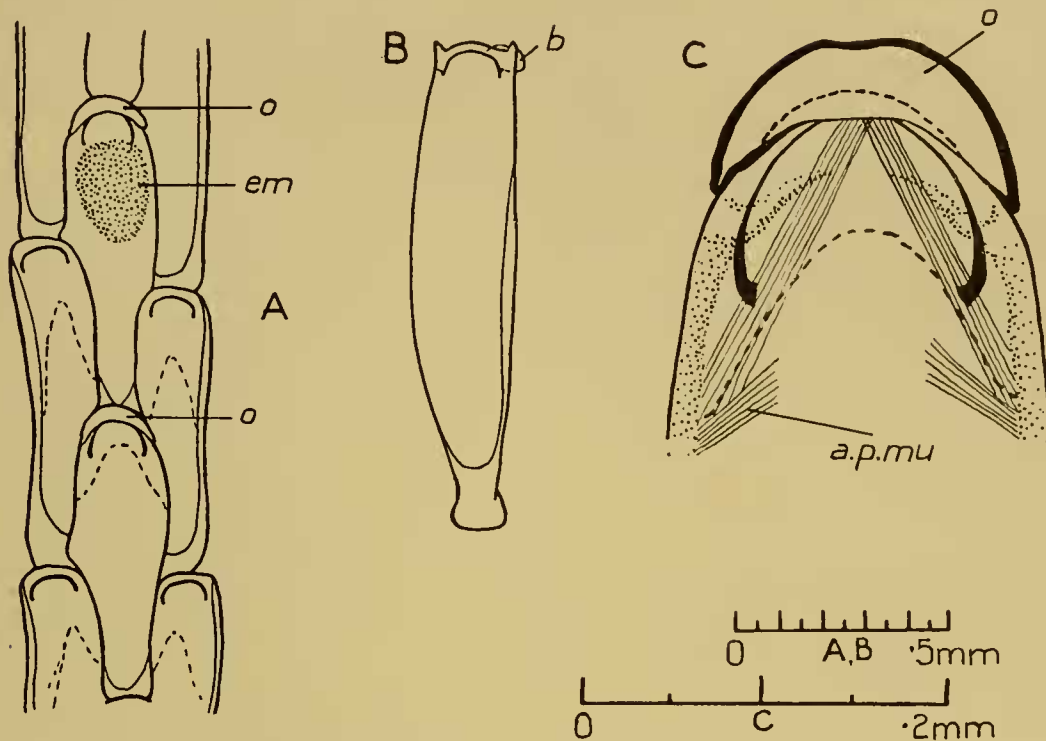


Fig. 37. A, C. *Himantozoum obtusum* sp.n. St. WS 228, off Patagonian Shelf. In Fig. C, showing an ovicell and the distal part of the fertile zooecium, the dotted lines indicate the frontal and basal limits of the oblique distal wall. The distribution of the funicular tissue (stippled) is related to the position of the embryo sac. B. *H. antarcticum* (Calvet). St. TN 194, off Oates Land. Ancestrula.  
*a.p.mu.* anterior bundle of parietal muscles, *b.* first bud, *em.* embryo, *o.* ovicell.

### 3. *Himantozoum sinuosum* (Busk).

*Bugula sinuosa* Busk, 1884, p. 39, pl. x, fig. 2.

*Himantozoum sinuosum* Harmer, 1923, p. 312; 1926, p. 453.

*Bugula sinuosa* var. *variabilis* (part) Kluge, 1914, p. 632, text-fig. 19 a (? pl. xxviii, fig. 6, not text-fig. 19 b).

? *Bugula sinuosa* var. *variabilis* Hasenbank, 1932, p. 332, text-fig. 7.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Prince Edward Island (Busk); Kerguelen (34.11.12.24, 25, Challenger Coll.); Southern Ocean, 3397 m. (Kluge); off East Africa? 1668 m. (Hasenbank).

In the type-specimen from Prince Edward Island (87.12.9.179) many of the zooecia of the inner rows are fertile. The ovicell forms a very shallow cap, the edges of its two layers being all that is visible in frontal view. It occupies the full width of the distal end of the zooecium between the pointed distal corners. In the inner series pointed corners are only present on fertile zooecia, the non-fertile zooecia having a rounded end. Busk's figure (pl. x, fig. 2a) shows five fertile zooecia and one non-fertile zooecium

in the inner series. The fertile zooecia have probably been overlooked hitherto because reproduction is at an early stage and in most instances the only evidence that a zooecium is fertile is the very inconspicuous ovicell and the presence of a small ovary similar to that described in *Himantozoum taurinum* by Harmer (1926, p. 455).

In describing *H. sinuosum* var. *variabilis* Kluge explained that he had insufficient material for comparison, and he made it clear that his treatment, as one variable variety, of the two forms recognizable in his material was tentative.

He gave three figures to illustrate the two extreme forms and an intermediate specimen. The first (text-fig. 19 *a*) only differs from Busk's figure of the typical form in the rounded ends of the zooecia of the inner rows, and it is clear from what I have said above that it is not to be distinguished from the typical form, the round-ended zooecia corresponding very closely with the non-fertile zooecia of the type.

The intermediate specimen (Kluge, 1914, pl. xxviii, fig. 6) has zooecia, with strongly arched ends and rather more sharply pointed corners, which might well be fertile. It much resembles the specimen figured by Hasenbank (1932, text-fig. 7) and they both have avicularia on zooecia of the inner as well as the outer series. It seems possible that these should likewise not be distinguished from the type. On the other hand, Braem's observations, discussed above, suggest that Hasenbank's specimens may have differed from the typical form in their alimentary canal.

Kluge described reduced ovicells in his variety which appear to have been similar to those now described in the typical form, but he did not say whether he had observed them in both forms of the variety. Hasenbank did not find ovicells in his specimens, although he observed fertile zooecia. As the ovicell is very inconspicuous and Hasenbank's figured fertile zooecia are similar in shape to those of the type, I am, however, not convinced that ovicells were not present.

If Kluge's intermediate specimen proved to belong to the typical form, the extreme form shown in his text-fig. 19 *b*, which is rather markedly different from the other figured specimens, would remain alone in var. *variabilis*.

#### 4. *Himantozoum sinuosum* var. *variabilis* (Kluge).

*Bugula sinuosa* var. *variabilis* (part) Kluge, 1914, p. 632, text-fig. 19 *b*.

*Himantozoum sinuosum* var. *variabilis* Harmer, 1923, p. 312.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Southern Ocean, 3397 m. (Kluge).

I have seen no specimen of this variety, which is discussed under *Himantozoum sinuosum*.

### Bugula Oken, 1815

#### 1. *Bugula calathus* Norman.

*Bugula calathus* Norman, 1868, p. 218, pl. vi, figs. 3-8; Kluge, 1914, p. 636, text-fig. 22 (references); Barroso, 1922, p. 94; Neviani, 1939, p. 18.

*Bugula flabellata* Hasenbank, 1932, p. 330, text-fig. 5 A; O'Donoghue and de Watteville, 1935, p. 208.

? not *Bugula calathus* Kluge, 1908, p. 518.

STATION DISTRIBUTION. *South Africa*: Sts. 91, MS 82.

GEOGRAPHICAL DISTRIBUTION. South-west Britain (Norman; Hincks); Mediterranean (Waters; Vigelius; Hincks; Calvet; Barroso; Neviani); South Africa (Kluge; Hasenbank; O'Donoghue & de Watteville; Discovery; 96.8.4.5, 7).

The frequent confusion between *Bugula calathus* and *B. flabellata* is due, in part at least, to an error in Hincks's *British Marine Polyzoa*, by which some of the figures on pl. xi were wrongly attributed in the text (1880, pp. 80, 82). The right attribution is given in the explanation of the plate: figs. 1-4 *B. flabellata*, figs. 5-8 *B. calathus*. The chief points of distinction are shown by Hincks, namely, the characters of the colony, the appearance of the zooecia in basal view, and the shape of the avicularia. The sharply down-turned beak of the avicularium of *B. flabellata* is particularly characteristic.

In view of its isolation from the other recorded localities, and the existence in the Arctic of other species that might be confused with *B. calathus*, I agree with Nordgaard (1918, p. 24) and Borg (1933, p. 528) that Kluge's record of *B. calathus* in the White Sea is doubtful.

Specimens from Waters's Naples collection (97.5.1.363, 364) confirm the identity of *B. avicularia* forma *flabellata* Waters (1879, p. 117) with *B. calathus*.

The South African specimen, recorded by O'Donoghue and de Watteville (1935, p. 208) as *B. flabellata* (1936.4.2.1), belongs to *B. calathus*, and it is evident from the figure given by Hasenbank (1932, p. 330) that he also had *B. calathus* before him. The specimen from O'Donoghue and de Watteville's collection shows the radial striation of the ovicell figured by Hasenbank.

True *B. flabellata* has not so far been proved to extend as far south as South Africa. In the absence of any other evidence that the species is found at the Cape, and in view of its frequent confusion with other species, I agree with Marcus (1920, p. 72) that Kirchenpauer's frequently quoted record (Hincks, 1880, p. 81) was probably erroneous. The geographical range of the species is, however, more extensive than Marcus then supposed, for he has since (1938a, p. 27) recorded it from Brazil, a region from which it is also represented in the British Museum (27.2.16.1).

The Discovery specimen of *B. calathus* shows the formation of new shoots from ancestrula-like zooecia budded from the outer distal corner of old zooecia as described below under *B. dentata* and *B. cucullata* var. *cuspidata*.

## 2. *Bugula cucullata* var. *cuspidata* var.n. Fig. 38 A-C.

STATION DISTRIBUTION. *New Zealand*: St. 935.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (St. TN 144; Discovery; 55.12.7.195).

HOLOTYPE. St. TN 144.

These *New Zealand* colonies differ from the *Australian* specimens of typical *Bugula cucullata* Busk (1867, p. 241) in their avicularia, ovicells and spines, and appear to represent a distinct variety. The avicularia, which are present on nearly every zooecium, are larger and more distally placed (Fig. 38 A). They have a convex or flattened upper profile with no concavity (cf. the avicularium of typical *B. cucullata* figured by Harmer,

1926, pl. xxxii, fig. 20), and there is a cusp on each side of the beak. The mandible has a pair of basal processes, not seen in typical *B. cucullata*. The ovicell is smaller and more cap-like (Fig. 38 B), and the spines are comparatively slender and of uniform width, in

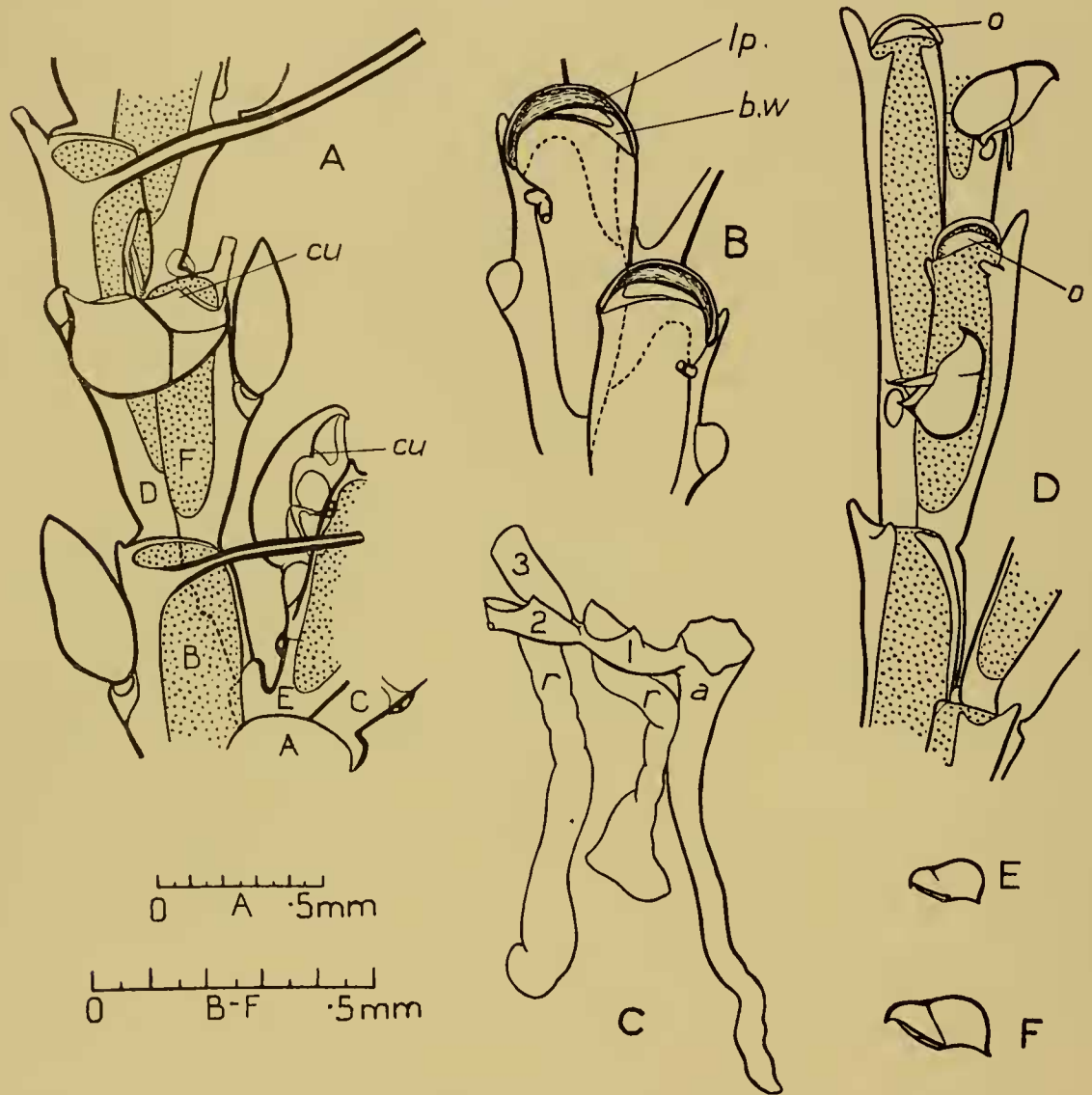


Fig. 38. A-C. *Bugula cucullata* var. *cuspidata* var.n. St. TN 144, New Zealand. A. Bifurcation lettered according to Harmer's scheme. The apparent joint in zoecia CE is probably an injury. B. Fertile zoecia. C. Young colony with ancestrula, drawn from dry specimen. D. *Bugula hyadesi* Jullien, 34.11.12.41. Challenger St. 315. E. *Bugula turrita* Verrill, 98.5.7.140. North-east America. Avicularium. F. *Bugula ditrupae* Busk. 99.7.1.1014. Madeira. Avicularium from a paratype-specimen. a. ancestrula, b.w. basal wall of ovicell, cu. cusp, lp. lip of ovicell, o. ovicell, r. rootlet, 1-3, first three zoecia.

contrast to the tapering, and often stout, spikes of the Australian specimens. When the two outer spines are of different size it is the distal one that is larger in Australian specimens, and the proximal one in var. *cuspidata*.



In both the typical form and the variety the outer distal corner of the zooecium is inrolled so that the proximal spine is directed more or less frontally. The Siboga material (Harmer, 1926, p. 447) has little or no inrolling of the corner, and the spines are both directed distally.

All these colonies of var. *cuspidata* have stout, usually annulate, rootlets, springing from the basal surface of the zooecia and passing, independently of each other and of the zooecia, to the substratum. In one of the Terra Nova colonies the branches spread fanwise above the surface of a *Cellepora* and drop these rootlets at such frequent intervals that they form a forest of rootlets. These rootlets are thickest at the end farthest from the colony. This colony has a very long, slender, turbinate ancestrula (Fig. 38 C). From the shape of its opesia it appears that it had spines all round it. It is very similar to that of typical *Bugula cucullata* figured by Harmer (1926, pl. xxx, fig. 7). The rootlets on the first two zooecia show little trace of the annulation which is such a marked feature of those, often longer, ones, that were formed subsequently. The main part of the colony is opaque, spineless and without avicularia. Here and there ancestrula-like zooecia have been budded from these presumably old zooecia and have given rise to fan-shaped, glistening shoots, with spines and avicularia. A similar budding process was seen in *B. calathus* and *B. dentata*.

### 3. *Bugula dentata* (Lamouroux).

*Acamarchis dentata* Lamouroux, 1816, p. 135, pl. iii, figs. 3 a, B.

*Bugula dentata* Harmer, 1926, p. 439, pls. xxx, figs. 5, 6, xxxii, figs. 21-25 (references); Livingstone, 1929, p. 53; Hasenbank, 1932, p. 329; Okada, 1934, p. 5, pl. i, fig. 9.

STATION DISTRIBUTION. *Cape Verde Islands*: St. 299.

GEOGRAPHICAL DISTRIBUTION. Madeira (Norman); Cape Verde Islands (Waters; Discovery); John Adams Bank, off Brazil (99.7.1.4618); South Africa (Krauss; Busk; Hasenbank; O'Donoghue; Harmer); Red Sea (27.5.23.1); Indian Ocean (Thornely); Amsterdam Island, Indian Ocean (Hasenbank); Malay Archipelago (Calvet; Marcus; Harmer); Australia (Lamouroux; Busk; MacGillivray; Waters; Kirkpatrick; Harmer); Tasmania (Busk); New Zealand (Busk; Livingstone); Japan (Ortmann; Yanagi and Okada; Marcus; Okada); Loyalty Islands (Philipps).

In the zooecia of this specimen the opesia is shorter than that described by Harmer, and the avicularium, which is as usual on the outer side of the zooecium, is attached at a point proximal to, or sometimes level with, the proximal end of the opesia. Such a condition is seen in parts, particularly the proximal part, of quite typical colonies (e.g. the specimen from Siboga St. 50, 28.3.6.280), and it is possible that the small colony obtained by the 'Discovery' would have produced zooecia with the longer opesia if it had developed further. Ovicells and enlarged trifoliate avicularia are absent from this specimen, and the spines are slender and without any distinct basal joint. The main colony is about 10 mm. long and complete basally, with ancestrula and basal tuft of rootlets. The older zooecia contain brown bodies and from this part of the colony spring eight adventitious branches each of which starts with an ancestrula-like individual and shows the usual gradual transition to zooecia of typical form. Each adventitious branch springs, apparently as a bud, from the distal part of the outer lateral wall of a zooecium,

i.e. from the inrolled corner below the insertion of the spines (cf. *B. calathus* and *B. cucullata* var. *cuspidata*).

4. *Bugula hyadesi* Jullien. Fig. 38 D.

*Bugula hyadesi* Jullien, 1888, p. 71, pl. vii, figs. 4-6; Calvet, 1904, p. 8.

? *Acamarchis brasiliensis* d'Orbigny, 1841, pl. iii, figs. 5-8; 1847, p. 10.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region (Jullien; Calvet); Falkland Islands (34. 11. 12. 41 from Challenger St. 315); Rio de Janeiro? (d'Orbigny).

A small specimen of this species found among unnamed material from Challenger St. 315 has very small cap-shaped ovicells (Fig. 38 D). Such an ovicell is evidently represented on one zooecium of the right-hand branch in Jullien's fig. 5.

*Bugula hyadesi* is distinguished from *B. ditrupae* (Fig. 38 F) by its less numerous distal spines (2 : 1 instead of 3 or 4 : 2); by its reduced ovicells; by its larger avicularia which are attached more proximally and have a more acute upper head-angle (see p. 396) and an almost rectangular lower head-angle; by its more delicate colony, with bifurcations of type 3, those of *B. ditrupae* being of type 5.

*B. hyadesi* appears to be related to *B. turrita* (see Fig. 38 E, and Osburn, 1912, p. 225) with which it agrees in the general shape of its zooecia and in its method of bifurcation. *B. hyadesi* is a more delicate species with bigger avicularia in which the beak forms a larger proportion of the total length. The avicularia are attached more proximally. The small, cap-like ovicell is quite unlike the globose ovicell of *B. turrita*.

Jullien found *B. hyadesi* on fronds of *Macrocystis* from the region of Cape Horn, and Calvet records a similar habitat. It seems probable that it is a synonym of *Acamarchis brasiliensis* d'Orbigny which was found on *Sargassum* off the coast of Brazil, where it was rare. D'Orbigny's fig. 5, which is natural size, represents a delicate species, similar to *Bugula hyadesi*, and figs. 7 and 8 show bifurcations of type 3, and long zooecia agreeing very exactly with those of *B. hyadesi*. In view of the small size of the ovicells it is not to be expected that d'Orbigny should have detected them with the instruments at his disposal and, though the avicularia seem to us conspicuous, Waters (1905b, p. 6) has shown that a large one was overlooked by d'Orbigny in *Acamarchis multiserialis*.

5. *Bugula neritina* (Linnaeus).

*Sertularia neritina* Linnaeus, 1758, p. 815.

*Bugula neritina* Marcus, 1937, p. 66, pl. xiii, fig. 34 (references); Neviani, 1939, p. 18; Hastings, 1939, p. 336.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. East and west temperate Atlantic (including Britain at Plymouth and Falmouth); east and west tropical Atlantic; Mediterranean; Suez Canal; Red Sea; Indian Ocean; Cape of Good Hope; Australia (west, south and east); Tasmania; Auckland Islands; New Zealand; Japan; California; Balboa; Galapagos Islands; Valparaiso; Falkland Islands.

The collection lent me by the U.S. National Museum included a specimen of *Bugula neritina* from Port William, Falkland Islands. The species is not otherwise known from

the Falkland region, as far as I am aware, and was probably introduced to the port by shipping (see Marcus, p. 67). As the sources of all the other recorded localities can be found through the references given by Marcus, I have not included them in my statement of distribution.

6. *Bugula longissima* Busk. Fig. 39 C, D.

*Bugula longissima* Busk, 1884, p. 42, pl. xxxi, fig. 7 a, b, c.

STATION DISTRIBUTION. *Antarctic*: Victoria Quadrant, St. 1660.

GEOGRAPHICAL DISTRIBUTION. Kerguelen; Heard Island (Busk); Ross Sea (Terra Nova; Discovery).

The colonies are rather large and straggling as compared with the more bushy colonies of the Challenger material. The Terra Nova colony (which is unfortunately completely decalcified) is 14 cm. long. Otherwise these specimens agree with the type.

The terminal branches are very delicate and transparent, slightly calcified and colourless, and are in striking contrast to the more proximal portions of the colonies, which consist of yellow horny zooecia, surrounded by rootlets. In the Terra Nova specimen the greater part of the colony consists of branching, cable-like stems formed by rootlets surrounding zooecia in this way.

The bifurcation is of type 4 (Harmer, 1926, p. 433), but is exceptional in that zooecia *E* and *F* are forked proximally like the rest of the zooecia, instead of coming to a single point (see Fig. 39 C, drawn from type-specimen). The connecting process, given off by zooecium *F* and joining the inner half of the forked end of *G*, is long and tubular, and is connected to the adjacent zooecium *E* by prominent rosette-plates. It thus looks like one of the runners of *Camptoplites*, although its morphological relations show it to be a connecting process.

The zooecia vary in length within the colony, and the "conical process" on the outer distal corner of the zooecium is not always present.

The ovicell is delicately calcified. The entoecium has a rather prominent median longitudinal ridge or suture and bears faint radial striations (Fig. 39 D), which are presumably the feature for which Busk used the expression "engine-turned". The ectoecium is considerably larger than the entoecium and is uncalcified frontally. The edge of the calcified hood-like part of the ectoecium is seen in some views as a point and led Busk to describe the ovicell as acuminate.

*Bugula lophodendron*, compared by Ortmann (1889, p. 24) to *B. longissima*, appears from his figure to have a bifurcation of type 3.

Yanagi and Okada (1918, p. 423) put *B. longissima* in the synonymy of *B. johnstonae* Gray. It is, however, markedly distinct from true *B. johnstonae* and from *B. longicauda* which may be the species identified as *B. johnstonae* by Yanagi and Okada (see Harmer, 1926, p. 450).

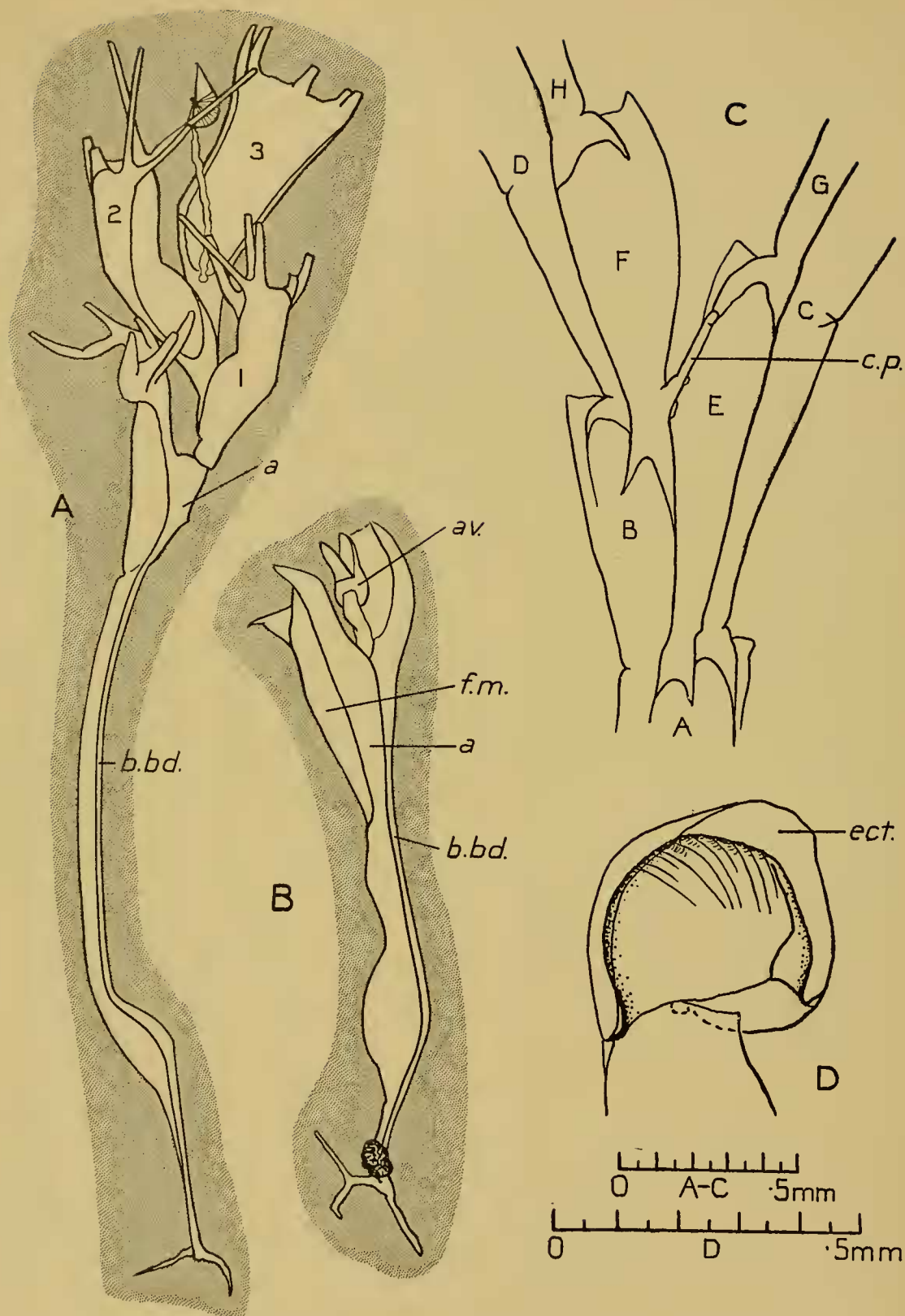


Fig. 39. A. *Camptoplites*. Ancestrula, species 7. St. TN 194, off Oates Land. B. *Camptoplites*. Ancestrula, species 1. St. 1652, Ross Sea. Attached Foraminiferan hides part of proximal portion. C. *Bugula longissima* Busk. 87.12.9.204. Challenger St. 151, Heard Island. Basal view of bifurcation of holotype. Zooecia lettered according to Harmer's scheme. D. *B. longissima* Busk. St. 1660, Ross Sea. Ovicell. a. ancestrula, av. avicularium, b.bd. basal band, c.p. connecting process, ect. edge of calcareous part of ectooecium, f.m. frontal membrane, 1-3, first three zooecia.

## Caulibugula Verrill, 1900

1. *Caulibugula tuberosa* Hastings.

*Caulibugula tuberosa* Hastings, 1939, p. 340, text-figs. 279 A-C.

STATION DISTRIBUTION. *New Zealand*: St. 934.

GEOGRAPHICAL DISTRIBUTION. *New Zealand* (Hastings).

## Kinetoskias Daniellsen, 1868

1. *Kinetoskias pocillum* Busk.

*Kinetoskias pocillum* Busk, 1881, p. 7, pl. i, figs. 2, 5; 1884, p. 45, pl. viii, fig. 2; Harmer, 1926, p. 468.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Off Valparaiso, 3953 m.; off Brazil, 58.6-732 m. (Busk).

## Camptoplites Harmer, 1923

GENERAL. *Camptoplites* was introduced by Harmer (1923, p. 300) and redefined by him (1926, p. 452). The abundant material before me suggests one modification of the definition. I do not think the zoarium is usually stalked. The stalk of *C. lunatus* consists of a bundle of the axillary rootlets, which are applied to the basal surface of the branch and so run together throughout their length. In the other species the axillary rootlets are free from the surface of the zoarium, and are attached singly to the substratum, and it is clear that a stalk, if present, would have to be formed in a different way from that of *C. lunatus*. Ancestrulae of several species are known (Figs. 39 A, B, 40, 41 A, B, 42 A, D). They agree in having a tubular proximal portion, ending in root-like structures by which the ancestrula is attached (see p. 437). As the growth of the colony proceeds this attachment is supplemented by axillary or marginal rootlets which pass to the substratum quite independently of the ancestrula, of the zooecia, and of each other (Figs. 41 A, 42 D). There is nothing in any of these instances to suggest that a stalk would subsequently have been formed. On the other hand, it is easy to imagine the delicate ancestrula, and probably also some of the other basal zooecia, breaking away leaving the colony attached by a number of independent rootlets, just as all the adult colonies (except that of *C. lunatus*) examined by me have been. It is hard to believe that if a stalk were characteristic of the genus no trace of it would have been found in my material.

In 1926 Harmer added to his earlier definition the statement that the connecting process at a bifurcation gives off two distal branches and a rootlet (e.g. Fig. 52 A). Examination of the Antarctic material shows that the constant feature is not the formation of the two distal branches or runners (though these are present at some or all bifurcations in the majority of the species), but the separation of the connecting process itself,<sup>1</sup> at least in those bifurcations that have produced an axillary rootlet, as a separate chamber from which the rootlet originates when present (Fig. 46 B). The axillary chamber can usually be seen to be connected with one of the neighbouring zooecia by a conspicuous rosette-plate (e.g. the large one on the left in Fig. 47 H). In most species the rootlet grows symmetrically and from the basal surface, but in *C. reticulatus*,

<sup>1</sup> Compare *Bugula longissima* Busk (p. 431 above).

*C. areolatus* (Fig. 54 A) and *C. rectilinearis* (Fig. 52 A) it is frontal, and in *C. asymmetricus* asymmetrical. Runners have not been seen in typical *C. bicornis*, *C. bicornis* var. *compacta*, or *C. tricornis* (Fig. 46 B). Where there is no rootlet the chamber is usually inconspicuous or absent, but in *C. retiformis* (Fig. 47 H), *C. latus*, *C. atlanticus* and *C. rectilinearis* a well-developed axillary chamber with runners is present whether there is a rootlet or not, and in *C. angustus* (Plate XII, fig. 3) the axillary chambers give rise to secondary branches (see p. 436), axillary rootlets being rarely formed. The formation of axillary secondary branches is occasionally seen in most forms possessing lateral secondary branches, but is not usual except in *C. angustus*.

The lateral rootlets also originate from chambers (e.g. Fig. 51 D). Except in *C. tricornis* (see Fig. 46 C and p. 451) and some young colonies (p. 441) these are placed basally and laterally in the angle between the narrow proximal end of one zooecium and the wider distal end of the preceding one (Figs. 47 I, J, 51 D). The secondary branches arise from these chambers, and a single chamber may produce both a rootlet and a secondary branch. In *C. giganteus*, *C. lewaldi*, *C. angustus*, *C. retiformis*, *C. latus*, *C. atlanticus*, *C. rectilinearis* and *C. reticulatus* the lateral chamber forms a runner (Fig. 47 I, J). In *C. tricornis* the chamber is prolonged distally but tapers gradually, no part of it being recognizable as a tubular runner (Fig. 46 C).

These arrangements are not peculiar to *Camptoplites*, for in a specimen of *Bugula* (*Dendrobeatia*) *birostrata* Yanagi and Okada (1918, p. 420) from Misaki (21.11.7.3, 500–600 fm.) the rootlets forming cross-connexions (cf. Silén, 1938, p. 237) arise from chambers with runners, like those of *Camptoplites*. The chamber figured by Yanagi and Okada has a mere protuberance in the position of the runner, but in the British Museum specimen runners are well formed.

The statement that the operculum is differentiated in *Camptoplites* is true, but perhaps misleading. An arc marking its edge can be seen in many zooecia, but it is very faint, far less distinct than that of *Cornucopina* for instance, and in many zooecia it cannot be detected at all.

AVICULARIA. The avicularia of *Camptoplites* are remarkable for their frequent profusion, diversity of form and length of stalk. The youngest stalks contain much tissue, and do not collapse or contract in preservation. In older stalks this tissue gradually disappears, and these may either contract longitudinally, when preserved, producing fine transverse striations as seen by Busk (1884, p. 41) and Calvet (1909, p. 9), or they may collapse and become crumpled, as described by Harmer (1926, p. 453). Part of a stalk may collapse while another part of the same stalk contracts (see for example *C. bicornis* var. *quadriavicularis*, slide 267 B<sup>4</sup> from St. 160). Contracted stalks give a strong superficial impression of muscular action, but specially preserved material would probably be necessary to settle, in such instances, whether contractile tissues were present, as stated by Busk and Calvet. Harmer did not find muscles in the avicularian stalks of *C. lunatus*, and throughout the genus the stalks of many apparently healthy avicularia contain little or no tissue of any kind. It is thus clear that musculature in the stalk cannot play an essential part in the functioning of these avicularia. All these questions may have to wait until living material can be observed.

A finger-shaped organ (cf. Marcus, 1939, p. 201) is highly developed in many of these avicularia (see Busk, 1884, p. 41, and my Figs. 43 D, F, J, 45 G).

In describing avicularia, the word "head" has been used in the past both for the muscle-chamber, as opposed to the rostrum or beak, and in a more general sense to cover the whole head including the beak (as, for example, in Kluge's terms long-headed and short-headed avicularia). I do not consider these two senses likely to lead to confusion and have continued to use both.

Typical bird's-head avicularia in which head and beak are more or less clearly distinguishable are present in *C. bicornis*, *C. lewaldi* and *C. giganteus*. They are of two kinds. In the larger kind the lower edge of the beak is curved to form a down-turned point (Figs. 43 D, F, J, 45 G). In the smaller kind the lower edge is straight (Fig. 43 C, K). These are the large and small long-headed avicularia of Kluge.

The other avicularia of *Camptoplites* have no clear demarcation of beak from head. They differ in size, in the curvature of the upper surface in profile, and in the relative lengths of the planes of the opesial and mandibular surfaces, and the angle between them. There are large, hook-shaped avicularia in which the two planes form an angle on the under surface of considerably less than  $180^\circ$  (Figs. 42 B, 46 D, 47 A, B, C, E, G, 48 D, 49 E, F, 52 B, 55 A, C, E, G) and smaller ones in which the under surface is almost or quite flat (Figs. 41 C, 42 C, 46 E, 47 D, F, 48 E, F, 51 B, 52 C, 55 B, D, F, H). These two types are widely distributed in the *C. reticulatus* group, defined below (p. 436), and are also found in *C. tricornis* and *C. angustus*.

The round-headed avicularia ("kurzköpfige avicularien" of Kluge), found with the long-headed forms in *C. bicornis*, *C. lewaldi* and *C. giganteus*, are only distinguished from the small, flat-surfaced type, just described, by their larger and stronger build and nearly circular outline. The whole head is at least as high as long (Fig. 43 A, B, G, H, M, N).

A curious point to be noticed in Kluge's figures, which is confirmed by examination of the present material, is that the oblique calcareous thickening, found at the junction of beak and head in the avicularia of *Bugula*, is usually absent in *Camptoplites*, but is present in the long-headed avicularia, both large and small, of *C. lewaldi* (Fig. 45 G) and *C. giganteus* (Fig. 43 J, K). It is also present in the small long-headed avicularia of *C. bicornis* var. *quadriavicularis* (Fig. 43 C), and sometimes in the large long-headed ones of that variety.

In both *C. giganteus* and *C. bicornis* var. *quadriavicularis* a few large round-headed avicularia have been seen at an early stage of development. The head is oval and clearly marked off from the stalk, and, before any calcification appears, contains much tissue, in which a cavity with narrow lumen and epithelial walls can sometimes be seen.

The presence of two avicularia on a single zoecium was noticed in *C. bicornis* and *C. reticulatus* var. *unicornis* by Harmer (1926, p. 452). Instances of this can be seen in several of Kluge's figures, and in all the species examined by me, except *C. lunatus* and *C. atlanticus*. The exceptions may perhaps be connected with the presence of only one kind of avicularium in these species, a supposition supported by the fact that the two avicularia on any one zoecium are usually of different kinds. Two of one kind have,

however, been seen in *C. asymmetricus* and *C. latus* var. *aspera*. I have never seen three avicularia on a single zoecium, as shown in Kluge's pl. xxviii, fig. 5.

The avicularia are attached to the proximal gymnocyst. One is always near the proximal border of the opesia, the other may be in close proximity to it (see scars in Kluge's pl. xxviii, figs. 3, 4 and 5, and my Figs. 49 D, 52 A, 54 B, C, D), or in a more proximal position (Kluge, pl. xxix, figs. 3 and 4, and my Fig. 44 A).

THE TWO GROUPS OF SPECIES OF *CAMPTOPLITES*. The species of *Camptoplites* form two groups; one characterized by the presence of large, erect hyperstomial ovicells (pl. v, figs. 3, 4 and Figs. 48 A-C, 49 A, B, C, 50 A, B, C, 51 C, 52 A, D, 53 A-D, 54 B, D) and the absence of secondary branches (short-celled branches, Waters, 1904, p. 21; rameaux secondaires, Calvet, 1909, p. 9; nebenäste, Kluge, 1914, p. 619); and the other characterized by the presence of secondary branches (e.g. pl. vi, figs. 1, 2; pl. vii, figs. 1-4; pl. viii, figs. 1, 3) and by the shallower ovicells, which are tilted backwards (Fig. 46 A), and may be a mere cap to the zoecium (Figs. 44 B-E, 45 A-F). The first, or *C. reticulatus* group, comprises *C. reticulatus*, *C. lunatus*, *C. retiformis*, *C. latus*, *C. atlanticus*, *C. rectilinearis*, *C. areolatus* and *C. asymmetricus*. The second, or *C. bicornis* group, comprises *C. bicornis*, *C. lewaldei*, *C. giganteus*, *C. angustus* and *C. tricornis*.<sup>1</sup> As far as its characters are known *C. abyssicolus* also comes into this group.

In both groups the lateral rootlets generally form connexions from branch to branch, while the axillary ones attach the colony to the substratum, so that where lateral rootlets are common, as in the species of the *reticulatus* group, the colony has a reticulate structure. In the *bicornis* group lateral rootlets may be abundant in the older part of the colony, but the branches are usually free distally, except in the specimen of *C. bicornis* var. *quadriavicularis* from St. WS 871 which is reticulate, and in some specimens of *C. tricornis*, which are matted.

In the species of the *reticulatus* group the appearance of the ovicell commonly changes with age, the primary radial sculpture being gradually overlaid by various types of reticulation or punctation (e.g. Fig. 48, A, B). It is therefore important, in describing ovicells of this group, to look for colonies in which a series of ovicells at different stages can be examined. It is also important that balsam preparations should be made, if the details of these changes are to be seen clearly.

The sculpture of the ovicells of the species of the *bicornis* group does not appear to change with age. In the reduction of the ovicells the species form a graded series from *C. angustus* (Fig. 46 A) in which they are tilted backwards, but are only a little smaller than those of the *reticulatus* group, through *C. abyssicolus* (Kluge, 1914, text-fig. 18), *C. tricornis* (Kluge, pl. xxix, fig. 6 and text-fig. 12a), *C. giganteus* (Fig. 45 E, F) and *C. lewaldei* (Fig. 45 C, D), to the varieties of *C. bicornis* (Figs. 44 B-E, 45 A, B, and Kluge, text-fig. 7c). The ovicells of the varieties of *C. bicornis* are not only much smaller in total size, but show nothing except their lip in frontal view. Those of typical *C. bicornis* are unknown.

ANCESTRULAE. The Discovery collection comprises a number of young colonies of *Camptoplites* with ancestrulae. The ancestrulae are all of the same general pattern, being

<sup>1</sup> See Addendum, p. 501.



more or less vase-shaped and tapering to a narrow stalk which bifurcates on the substratum to form two main attaching rootlets (Figs. 39 A, B, 40, 41 A, B, 42 A, D). These rootlets may be further branched. The first zoecium springs from the ancestrula near the distal end but is continued down the basal surface of the ancestrula by a structure that I have called the basal band (*b.bd.* in figures).

Within this general plan the ancestrulae show differences in the length and shape of both the stalk and the opesia, and in the number of spines, by which seven species appear to be recognizable. Species 1 and 7 (Fig. 39 A, B) resemble each other, and

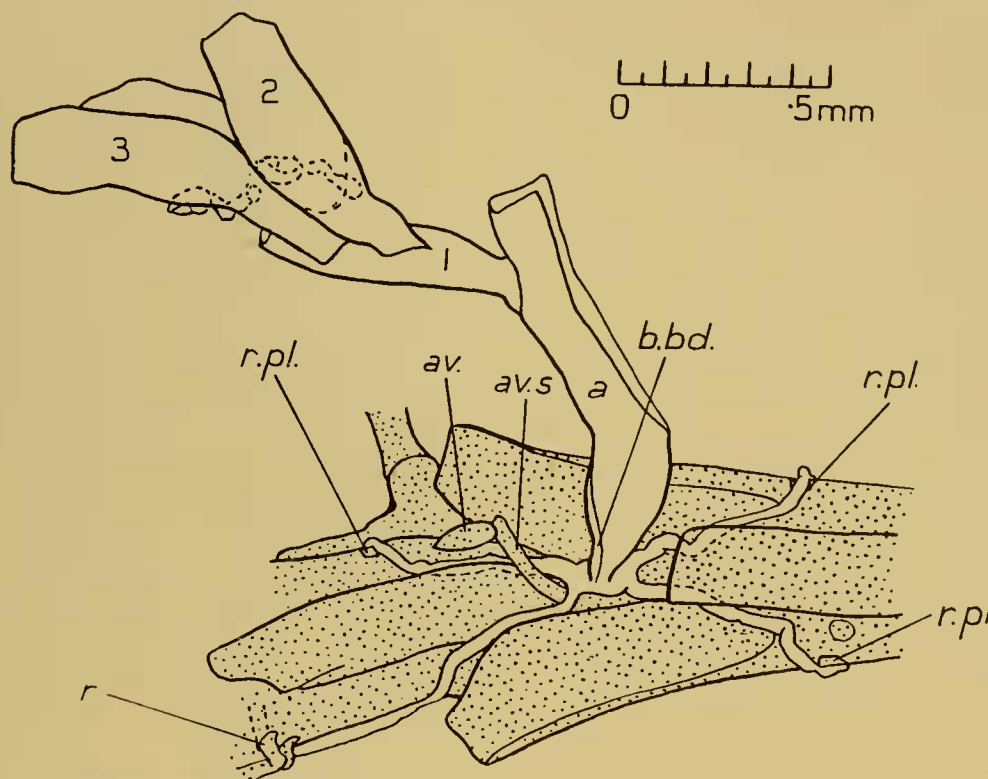


Fig. 40. *Camptoplites*. Young colony with ancestrula, species 2, attached to type-material of *C. atlanticus*. St. WS 773, off Patagonian Shelf. Ancestrula is attached to the frontal surface of the supporting colony, which is stippled, and the roots can be seen passing round the stalk of an avicularium, and under the raised borders of the distal parts of the zoecia.

*a.* ancestrula, *av.* avicularium, *av.s.* avicularian stalk, *b.bd.* basal band, *r.* tips of two rootlets meeting root of ancestrula, *r.pl.* rosette-plate, 1-3, first three zoecia, seen in basal view, the avicularia and opesiae (dotted lines) seen through the zoecia by transparency.

differ rather markedly from the others in the shape of the ancestrula. Species 2 (Fig. 40) has no spines at all, and an ancestrula of rather different shape from any of the others. Species 3-6 (Figs. 41 A, B, 42 A, D) have ancestrulae of similar shape and are chiefly distinguished by the distribution of spines on the ancestrula and succeeding zoecia (see Table 2). A key for the discrimination of the species follows the table. Having thus defined the species it will be possible to discuss their relationship to the adult forms.

Table 2. *Distribution of spines on young colonies of Camptoplites, species 3 to 6*

*A*, ancestrula.  $Z^1, Z^2$ , etc., zoecia in order of their formation. A single figure indicates an uninterrupted series of distal spines. Figures separated by a colon (3 : 1) indicate the number of outer and inner distal spines. Figures separated by a plus sign (9 + 1) indicate the number of distal and proximal spines. A bracket represents a bifurcation. A black terminal line indicates that the whole specimen or branch has been tabulated.

The bracket follows zoecium B (Harmer's lettering), and the numbering for each branch continues in the order of the formation of the zoecia starting with the inner (axillary) zoecium at the base of the branch.

To correspond with the numbering in the table the zoecia in Fig. 41 B marked 5, 6 and 4 should be 4, 4 and 5 respectively.

Station	<i>A</i>	$Z^1$	$Z^2$	$Z^3$	$Z^4$	$Z^5$	$Z^6$
<b>Species 3</b>							
WS 42 (F)	8 + 1	8	3 : 2	3 : 2	3 : 2	3 : 1	6
187	10 + 1	6	5	2 : 2	?	2 : 1	?
1652	6 + 1	7	7	6	6	{ 6 5	5 6
1652	8 + 1	7	6	5	6	5	
Gauss station as <i>multispinosa</i>	10 + 1	7	6	7	6	7	{ 6 7
<b>Species 4</b>							
181 (F)	9 + 1	4 : 2	3 : 1	2 : 1	{ ? 2 : 1	?	
181	7 + 1*	3 : 2	3 : 1	2 : 1	{ 2 : 1 ?	? ?	? ?
181	10	3 : 1	?	0			
Belgica as <i>spinosa</i>	6	3 : 2	2 : 1	2 : 1	2 : 1		
<b>Species 5</b>							
WS 42	4 : 3	3 : 1	3 : 1	3 : 1			
WS 42	4 : 4	2 : 1					
181 (F)	5 : 4	4 : 2	3 : 1	3 : 2	3 : 1	2 : 1	2 : 1
<b>Species 6</b>							
181	?	?	2 : 2	2 : 1	2 : 1	2 : 1	{ 2 : 1 2 : 1
181	2 : 2	2 : 2					
181 (F)	2 : 2	2 : 2	2 : 1	2 : 2	{ 0 ?	2 : 1	2 : 1
1660	1 : 1	2 : 1	?				
Nat. Ant. Exp.	2 : 2	2 : 1					
E. end Barrier							

\* Spines on ancestrula represented by obscure stumps.

F. Figured specimen.

### Key to the ancestrulae of *Camptoplites* in the collections

1. Ancestrula with long stalk, with a swelling near its base, distal part of ancestrula flattened (i.e. distinctly broader from side to side than thick from frontal to basal surface) ... 2  
Ancestrula with moderate or short stalk without swelling, distal part not flattened... 3
2. Distal corners pointed, no spines, stalk forms little more than half of total length of ancestrula ... .. Species 1  
Distal corners bear spines and are drawn out giving appearance of a branched spine, a median distal spine on ancestrula and first zoecia, stalk forms more than two-thirds of total length of ancestrula ... .. Species 7

- |   |     |     |     |     |     |     |     |     |     |     |           |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----------|
| 3. Spines absent  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | Species 2 |
| Spines present  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4         |
| 4. Ancestrula has a single series of distal spines and usually one proximal spine                       | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 5         |
| Ancestrula has distal spines in two groups and no proximal spine  | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 6         |
| 5. Separation of distal spines into two groups appears at first zoecium                                 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | Species 4 |
| The first-formed zoecia have a single series of distal spines, separation into two groups appears later | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | Species 3 |
| 6. Opesia short, ancestrula with three to five spines at each corner                                    | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | Species 5 |
| Opesia long, ancestrula with one or two spines at each corner   | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | Species 6 |

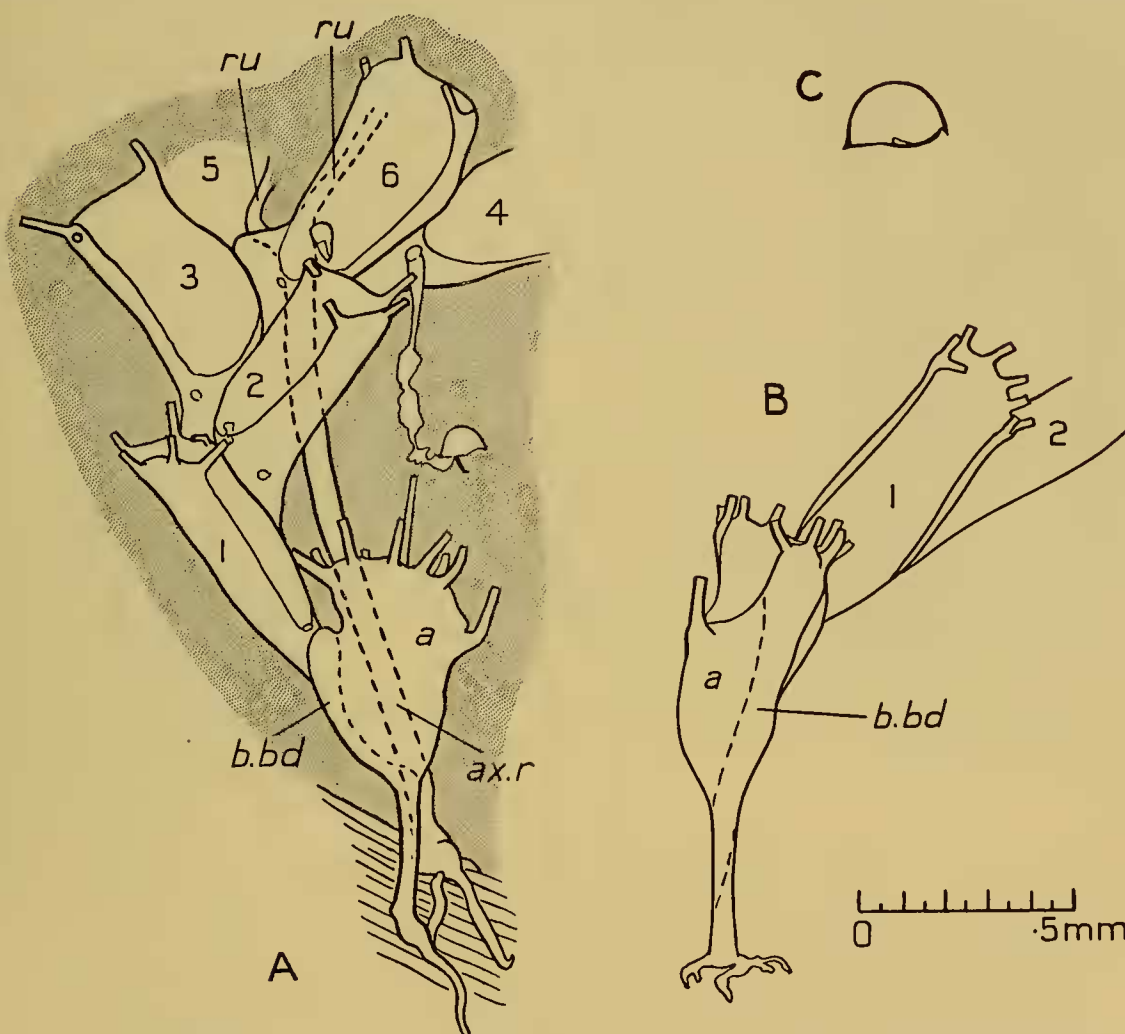


Fig. 41. A. *Camptoplites*. Ancestrula, species 4. St. 181, Palmer Archipelago. The stalk of one of the avicularia is indistinguishable. B. *Camptoplites*. Ancestrula, species 3. St. WS 42, South Georgia. The appearance of a ninth distal spine to the right of the ancestrula is erroneous. C. *Camptoplites*. Ancestrula, species 3. St. 1652, Ross Sea. Avicularium.

a. ancestrula, ax.r. axillary rootlet, b.bd. basal band, ru. runner, 1-6, zoecia.

*Relationship of ancestrulae to adult forms*

*Species 1* (Fig. 39 B). The general character of these four young colonies suggests the *C. bicornis* group, and the avicularia, which may be present on the first zoecium,

resemble the large long-headed ones of var. *compacta*. Only a tentative identification is, however, possible.

*Species 2* (Fig. 40). These specimens are evidently young colonies of the spineless species, *C. atlanticus*, with which they were found (see p. 460).

*Species 3* (Fig. 41 B, C). These specimens closely resemble *C. multispinosus* (Kluge, 1914, p. 628, pl. xxx, fig. 2).

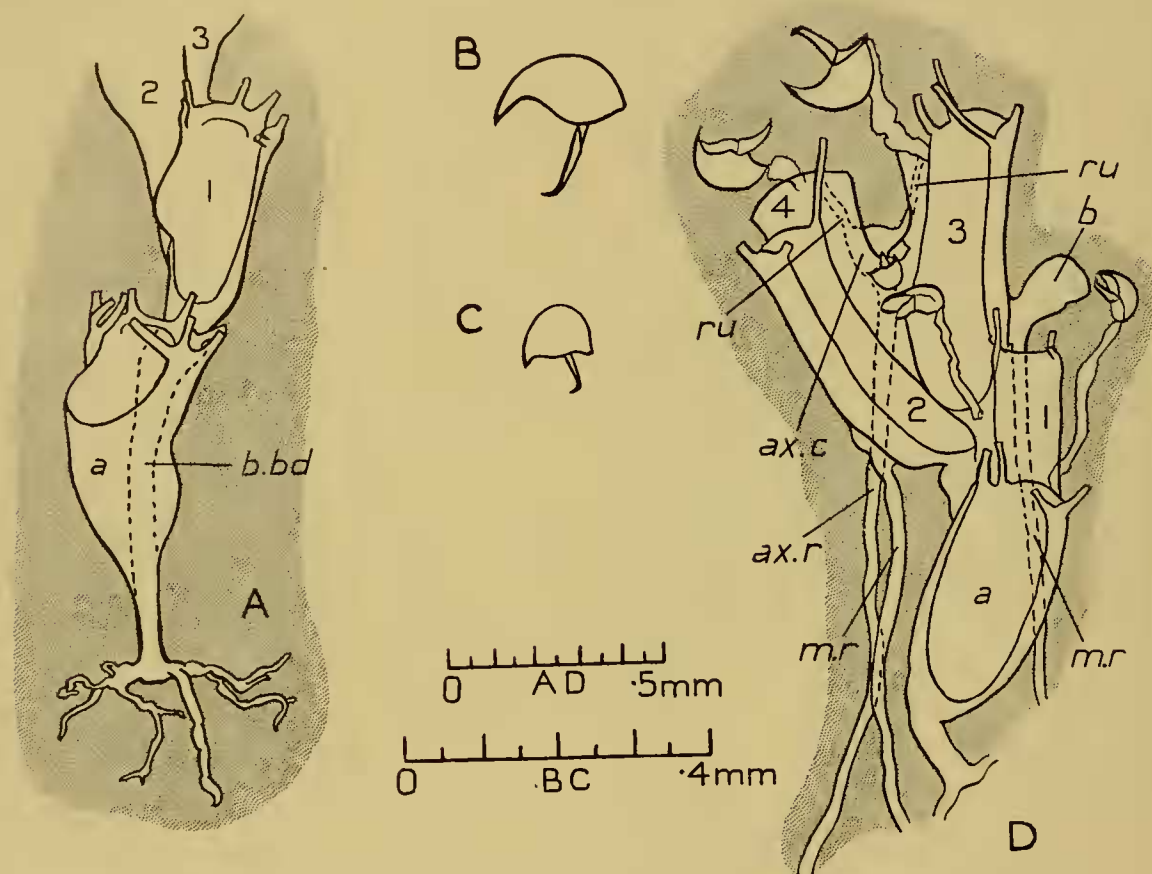


Fig. 42. A-C. *Camptoplites*. Ancestrula, species 5. St. 181, Palmer Archipelago. A. Ancestrula and first zooecia. B, C. Avicularia. D. *Camptoplites*. Ancestrula, species 6. St. 181, Palmer Archipelago. The small avicularium on zooecium 4 is foreshortened. The left-hand branch, drawn as if it ended, was continued, see Table 2, p. 438.

*a.* ancestrula, *ax.c.* axillary chamber, *ax.r.* axillary rootlet, *b.* bud, starting secondary branch, *b.bd.* basal band, *m.r.* marginal rootlet, *ru.* runner, 1-4, first four zooecia.

In spite of Kluge's opinion that colonies of this type represent a distinct species, I have no doubt that they are young colonies of some other form. They are all small colonies with few zooecia and the ancestrula intact, and the small size of the zooecia and more numerous spines are both characteristic features of the early stages of a colony. The colonies are not far enough advanced for recognition of the species.

The separation of the distal spines into two groups may be faintly indicated at the second or third zooecium, or not till after the second bifurcation, as in Kluge's figure,

by which time a dozen zooecia with the distal spines in a single series may have been formed.

*Species 4* (Fig. 41 A). Here also the colonies have not developed far enough for specific determination.

The young colony described by Waters as *Bugula reticulata* var. *spinosa* (1904, p. 22, pl. i, fig. 3 a, b) has a similar distribution of spines, and, like one of the specimens of species 4, has no proximal spine on the ancestrula; but it has rootlets like those of species 6. Kluge put Waters's form doubtfully in the synonymy of his *Bugula* sp. var. *variospinosa* (Kluge, 1914, p. 628, pl. xxviii, fig. 4) which I take to be a young colony of *Camptoplites areolatus* (see p. 465). Waters's figure differs from Kluge's in the zooecia which are more broad and square distally and diverge more from the axis of the colony; in the opesia which is longer, less definite, and without cryptocyst; and in the absence of any zooecia with more than one avicularium (see paired scars in Kluge's figure); differences which appear to me to be of specific value.

*Species 5* (Fig. 42 A-C). The colony from St. 181 has developed far enough to show the characteristics of the zooecia and avicularia of *C. retiformis*.

*Species 6* (Fig. 42 D). The avicularia show that this is *C. angustus*. The presence of what appears to be a secondary branch, of spines, and of axillary runners fits this conclusion.

The presence of lateral rootlets springing from the side of the zooecium, and not from the angle between two zooecia, suggests *C. tricornis*, but rootlets of this kind are apparently found in the young colonies of more than one species, as they are shown by Waters in a young colony which agrees better with species 4 than species 6.

*Species 7* (Fig. 39 A). There are two colonies with ancestrulae of this type. The one shown in the figure consists of the ancestrula and first few zooecia and has not developed far enough for identification. The other, from St. TN 194, is a large and characteristic specimen of *C. bicornis* var. *elatior*, and, although a little damaged, the ancestrula and first few zooecia agree so well with those of the other colony as to leave no doubt of the specific identity of the two.

#### Key to the species of *Camptoplites*

- |  |                       |
|--|-----------------------|
| 1. Secondary branches usually present, <sup>1</sup> ovicells tilted backwards and more or less shallow, their radial sculpture not changing markedly with age ... .. | 2                     |
| Secondary branches absent, ovicells large, usually radially striated at first and with additional sculpture later <sup>2</sup> ... ..                                | 7                     |
| 2. Avicularia of various types including small long-headed avicularia with straight beak ...   | 3                     |
| Avicularia do not include the small long-headed type ... ..  | 5                     |
| 3. Main branches biserial, rarely more series at bifurcation, secondary branches not fan-shaped (for key to varieties see p. 445) ... ..                             | 1. <i>C. bicornis</i> |
| Some, at least, of the main branches with more than two series of zooecia, secondary branches fan-shaped (i.e. much branched) ... ..                                 | 4                     |

<sup>1</sup> Absent in the fragmentary specimens of typical *C. bicornis* and not reported in *C. abyssicolus*.

<sup>2</sup> No radial phase known in *C. reticulatus*. No additional sculpture known in *C. lunatus*, *C. asymmetricus* and *C. atlanticus*.

4. Round-headed avicularia with long down-turned beak, large long-headed avicularia sinuous dorsally (i.e. with concavity at beginning of beak) ... .. 7. *C. giganteus*  
 Round-headed avicularia with small down-turned beak, large long-headed avicularia convex or straight dorsally<sup>1</sup> ... .. 6. *C. lewaldi*
5. Avicularia all alike, branches biserial ... .. 9. *C. abyssicolus*  
 Avicularia of two kinds, main branches with more than two series of zooecia ... .. 6
6. Three strong spines (of which one is median) on each non-fertile zooecium, large avicularia with pointed posterior process on each side, axillary secondary branches exceptional ... .. 8. *C. tricornis*  
 Spines not median, avicularia without pointed processes, axillary secondary branches common ... .. 10. *C. angustus*
7. Axillary rootlets adhering to basal surface of branch, outer distal corner of zooecium turning forwards ... .. 19. *C. lunatus*  
 Axillary rootlets not adhering to basal surface, outer distal corner not turning forward (though spine may) ... .. 8
8. Cryptocyst present, zoarium biserial and jointed, lateral rootlet-chamber without runner ... 9  
 Cryptocyst absent, zoarium biserial or pluriserial, unjointed, lateral rootlet-chamber with runner ... .. 10
9. Axillary rootlet issues frontally and symmetrically, internal projection from basal wall of zooecium present, opesia usually short ... .. 20. *C. areolatus*  
 Axillary rootlet issues basally and asymmetrically, no internal projection from basal wall, opesia usually long ... .. 21. *C. asymmetricus*
10. Zoarium biserial, sometimes triserial in part, a single distal spine originating from basal surface of outer corner of some zooecia ... .. 18. *C. reticulatus*  
 Zoarium pluriserial, spines, when present, on either or both of the distal corners, not basal 11
11. Zooecia very long, narrow, straight-sided, axillary rootlets issuing from frontal surface of chamber ... .. 17. *C. rectilinearis*  
 Zooecia not very long, narrow or straight-sided, axillary rootlets issuing from basal surface of chamber ... .. 12
12. Spines present, avicularia of two kinds, large and small, ovicells radially striated at first, with additional sculpture later ... .. 13  
 Spines absent, avicularia all small, ovicells radially striated or fluted, without additional sculpture ... .. 16. *C. atlanticus*
13. Spines directed frontally, zooecia not raised distally, large avicularia with long stalks, small avicularia very variable in size, their lower head-angle about 90° ... .. 14  
 Spines, with few exceptions, directed distally, zooecia somewhat raised distally, large avicularia short-stalked, small avicularia not very variable in size, their lower head-angle acute 15
14. Fully calcified ovicells rather heavily reticulate, some, at least, of the meshes more or less hexagonal, fertile zooecia with one or both spines long and stout ... 11. *C. retiformis*  
 Fully calcified ovicells with light, irregular reticulation, not forming hexagonal meshes, spines on fertile zooecia not enlarged ... .. 12. *C. retiformis* var. *tenuispina*
15. Fully calcified ovicell sparsely punctate, large avicularia not on marginal zooecia 13. *C. latus*  
 Fully calcified ovicell not punctate, large avicularia usually on marginal zooecia ... .. 16
16. Fully calcified ovicell radially striated, not thickened or roughened, reticulation, if any, faint, spines directed distally, large avicularia round-backed ... 14. *C. latus* var. *striata*  
 Fully calcified ovicell thickened and roughened after a distinct reticulate phase, spines variable directed distally or obliquely forward, large avicularia flat-backed  
 15. *C. latus* var. *aspera*

<sup>1</sup> One specimen had a second type of large long-headed avicularium.

1. *Camptoplites bicornis* (Busk).

*Bugula bicornis* Busk, 1884, p. 40, pl. ix, fig. 1 *a-e*; Kluge, 1914, p. 622, text-fig. 7 *d-f*.

*Camptoplites bicornis* Harmer, 1923, p. 300.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Southern Ocean, 53° 55' S, 108° 35' E, 3568 m. (Busk).

Secondary branches are not to be found in the type specimens of *Camptoplites bicornis* (87.12.9.196, 197; 99.7.1.271, 1013) which are fragmentary, and they are not shown by Busk. They might nevertheless be present in complete colonies. All three types of avicularia are present, as shown in the figures of Busk and Kluge (whose figures of the avicularia were drawn from one of Busk's preparations).

*The varieties of Camptoplites bicornis*

The Discovery collections include the three forms treated by Kluge as varieties of *C. bicornis*, and one, *C. bicornis* var. *quadriavicularis*, hitherto undescribed. The specimens of var. *magna* belong to forma *elongata*, forma *ventricosa* not being represented.

Kluge's varieties are clearly recognizable from his descriptions although there are discrepancies in the explanation of pl. xxix in which the main and secondary branches of var. *compacta* and var. *elator* purport to be represented in four separate figures.

Fig. 1, described as a main branch of var. *compacta*, appears to represent two secondary branches with two zoecia of a main branch. It resembles the less compact specimens of var. *compacta* which is somewhat variable in the character from which it gets its name. Fig. 2 shows very compact secondary branches of the same variety.

Figs. 3 and 4, described as main and secondary branches respectively of var. *elator*, both show main branches with small secondary branches. They clearly represent distinct varieties and, as they show all the main features of var. *magna* (which is not otherwise figured) and var. *elator*, it seems likely that the plate was intended to show the main features of all three varieties and that a mistake was made in compiling the explanation. Unfortunately, the magnification of the figures is not given, so that a comparison of absolute dimensions cannot be made. The large long-headed avicularia in fig. 3 have a slightly more acute upper head-angle than any in Kluge's range for var. *magna* form *elongata* (115° as compared with 133–160°), but agree with the smallest avicularia found in my material of var. *magna*.

The little points on each side of the terminal point of the mandible of the round-headed avicularia (Fig. 43 N), which were figured by Kluge (fig. 9c, p. 623) in var. *elator* and mentioned in his description of var. *magna* can be found in both varieties.

In addition to the differences noted by Kluge, the varieties appear to be distinguished by their ovicells. The ovicell of var. *compacta* was well figured by Kluge (text-fig. 7c). The proximal expansion shown in the figure is the base of the distal zoecium. Waters (pl. i, fig. 4a) also shows this ovicell quite well. It occupies less than two-thirds of the width of the zoecium, the distal corners of which rise to a point on either side of it (Fig. 44 C). At each side, where it joins the ovicell, the distal wall is thickened and

prominent, and this calcareous thickening is sometimes continued down the sides of the ovicell.

In var. *elator* the ovicell is flanked by the pointed corners of the zooecium as in var. *compacta*, but is wider in proportion to the width of the zooecium and there is no marked thickening of the shoulders (Fig. 44 D).

In var. *magna* the ovicell occupies nearly the whole width of the zooecium, the distal corners being small and inconspicuous, the lateral walls of the ovicell converge at an obtuse angle and there is no thickening of the shoulder (Figs. 44 E, 45 A, B).

In var. *quadriavicularis* the ovicell is as wide as the distal end of the zooecium (Fig. 44 A, B).

In all four varieties the rosette-plates connecting the ovicell with the distal zooecium are very variable, and the ovicell may be symmetrical or asymmetrical according to the position in which the distal zooecium arises from the fertile zooecium.

The type material of *C. bicornis* agrees with Kluge's varieties in the absence of the thickening at the base of the avicularian beak. This thickening is present in some of the long-headed avicularia of *C. bicornis* var. *quadriavicularis*.

The correlated differences in the general build of the colony (cf. pl. X, figs. 1-3), the form of the zooecia (pl. XI, figs. 1-3 and Kluge's figures), the avicularia and the ovicells are such that these forms might well be given specific rank, but, until more is known of typical *C. bicornis*, I have preferred to leave untouched Kluge's classification of them as varieties of that species.

Both Kluge (1914, p. 621) and Waters (1904, p. 21) refer to cross-connexions between the branches in *C. bicornis*. In my material these connexions are found in the older parts of the colonies, and may be numerous, but, except in one specimen of var. *quadriavicularis*, they are very irregular in arrangement and the tips of the branches are free.

Livingstone's material (1928, p. 27) was not in good enough condition for him to determine its relation to Kluge's varieties, and has therefore had to be omitted from my statements of distribution.

Calvet (1909, p. 8) evidently included at least two species in *C. bicornis*, as noticed by Kluge (1914, p. 621). Both had secondary branches and the three types of avicularia found in *C. bicornis* and several other members of the *bicornis* group. The specimen from Booth-Wandel Island had biserial branches which became tri- or quadriserial at the bifurcations. As the only known members of the *bicornis* group showing this character are *C. bicornis* var. *quadriavicularis*, which has four kinds of avicularia, and *C. giganteus*, Calvet's specimen may have belonged to *C. giganteus*. The specimens from Schollaert Bay had three to ten series of zooecia. This clearly distinguishes them from any of the varieties of *C. bicornis* and points to *C. lewaldei* as the only known form with which they agree. A process of elimination thus suggests that Calvet had *C. giganteus* and *C. lewaldei*, but there is not positive evidence to prove either suggestion.

Ancestrulae believed to belong to two of the varieties of *C. bicornis* are described above (pp. 438, 439), as species 2 and species 7.



*Key to the varieties of Camptoplites bicornis in the present collections*

1. Small long-headed avicularia with thickening where beak joins head (as in *Bugula*), round-headed avicularia usually of two sizes ... .. 5. var. *quadriavicularis*  
 Avicularia without thickening where beak joins head, round-headed avicularia all of one size ... .. 2
2. Ovicell occupying less than two-thirds of width of zoecium, large long-headed avicularia relatively small, fairly uniform in size, their upper head-angle less than 100°  
 ... .. 2. var. *compacta*  
 Ovicell occupying more than two-thirds of width of zoecium, large long-headed avicularia variable in size mostly relatively large, their upper head-angle at least 115°, usually more 3
3. Zoecia tapering proximally fairly gradually, zoecia of main branches considerably longer than those of secondary branches, distal corners not conspicuously pointed  
 ... .. 3. var. *magna*  
 Zoecia narrowing rather suddenly at beginning of tubular part, zoecia of main branches not markedly different from those of secondary branches, distal corners drawn out into almost spine-like points ... .. 4. var. *elatiior*

2. *Camptoplites bicornis* var. *compacta* (Kluge). Plates X, fig. 1, XI, fig. 1; Figs. 43 M, 44 C.

*Bugula bicornis* var. *compacta* Kluge, 1914, p. 619, pl. xxix, figs. 1, 2, text-figs. 7 a-c, 8 (not text-fig. 7 d-f, see *C. bicornis*).

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 187; Victoria Quadrant, Sts. 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. Palmer Archipelago (Discovery); Bellingshausen Sea; Wilhelm II Land (Kluge); Ross Sea (National Antarctic Expedition; Terra Nova; Discovery).

The varieties of *Camptoplites bicornis* are compared on p. 443.

The upper head-angle of the large long-headed avicularia of my material may be as much as 100° though it is usually nearer 80°.

Kluge (p. 622) explains that the avicularia in his text-fig. 7 were drawn from the type specimen of *C. bicornis* and not from var. *compacta*.

3. *Camptoplites bicornis* var. *magna* (Kluge). Plates X, fig. 2, XI, fig. 2; Figs. 44 E, 45 A, B.

*Bugula bicornis* var. *magna* form *elongata* Kluge, 1914, p. 623, text-fig. 10.

*Bugula bicornis* var. *elatiior* (part) Kluge, 1914, pl. xxix, fig. 3.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 39, 164, 180, 187 and Deception Island; Victoria Quadrant, Sts. 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia; South Orkney Islands; South Shetland Islands; Palmer Archipelago (Discovery); Bellingshausen Sea; Wilhelm II Land (Kluge); Ross Sea (Terra Nova; Discovery).

The varieties of *Camptoplites bicornis* are compared on p. 443.

The large long-headed avicularia of my material of var. *magna* are all of the type of Kluge's form *elongata*. They correspond in size and general shape to the smaller avicularia of the series figured by Kluge, but the smallest are even smaller. These smallest ones approach those of var. *compacta* in size but have a more obtuse upper head-angle (115°).

As a result of the absence of the larger sizes of large long-headed avicularia in my material of var. *magna* there is no noticeable difference from var. *elatiior* in range of size, but the upper head-angle is usually more obtuse in the latter form. Waters's specimen, attributed to var. *magna* by Kluge, was also without large long-headed avicularia of maximum size.

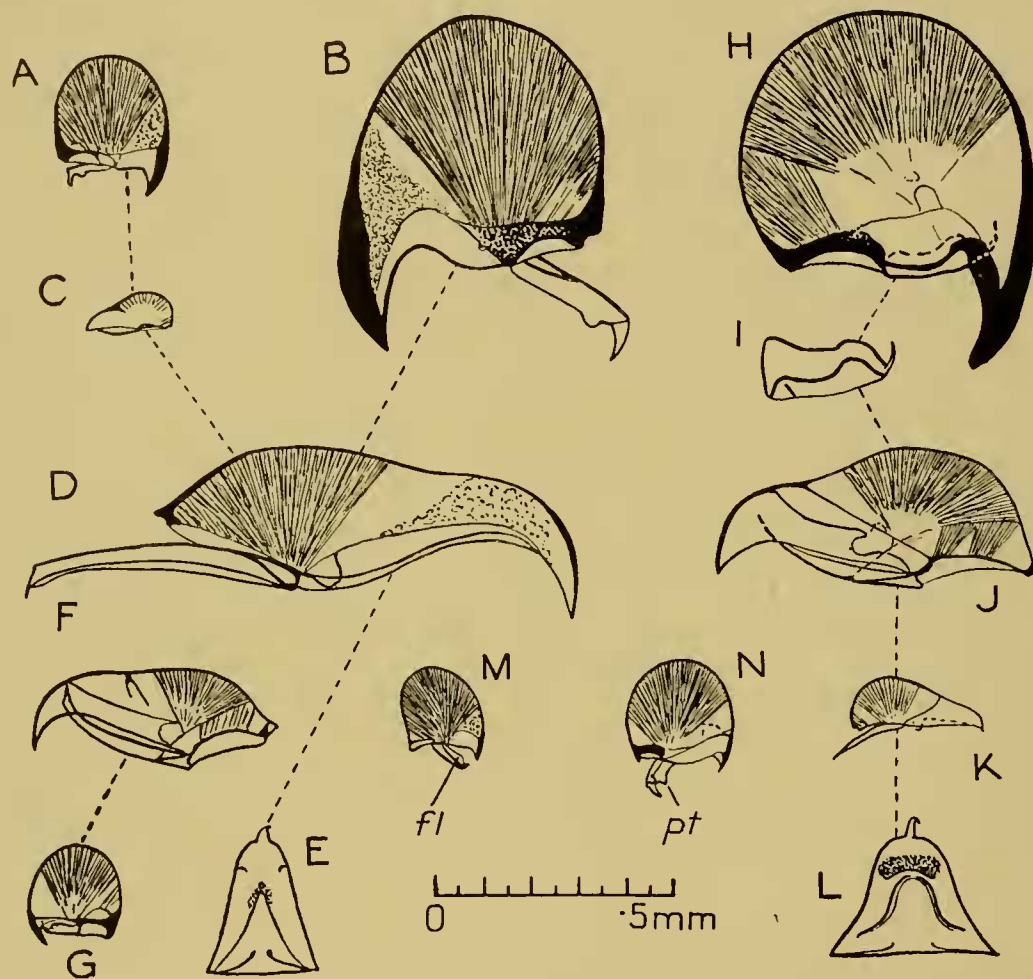


Fig. 43. Avicularia of *Camptoplites giganteus* and of some varieties of *C. bicornis*. A-E. *C. bicornis* var. *quadriavicularis* var.n. From the type-specimen, St. 160, Shag Rocks. A. Small round-headed. B. Large round-headed. C. Small long-headed. D. Large long-headed. E. Mandible of large round-headed avicularium. F, G. *C. bicornis* var. *quadriavicularis* var.n. From the specimen from St. WS 871, off Patagonian Shelf. Small long-headed not figured. F. Large long-headed. G. Round-headed. H-L. *C. giganteus* (Kluge). St. WS 33, South Georgia. H. Round-headed. I. Mandible of round-headed, oblique lateral view. J. Large long-headed. K. Small long-headed. L. Mandible of round-headed avicularium. M. *C. bicornis* var. *compacta* (Kluge). St. TN 339, Ross Sea. Round-headed avicularium. N. *C. bicornis* var. *elatiior* (Kluge). St. 180, Palmer Archipelago. Round-headed avicularium.

fl. flange, pt. point.

A small specimen from St. 39 (South Georgia) has no round-headed avicularia, but is otherwise typical, and in the large colony from St. 180 (Palmer Archipelago) the avicularia are all of the small long-headed type.

4. *Camptoplites bicornis* var. *elator* (Kluge). Plate XI, fig. 3; Figs. 43 N, 44 D.

*Bugula bicornis* var. *elator* Kluge, 1914, p. 622, pl. xxix, fig. 4, text-fig. 9 (not pl. xxix, fig. 3).

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 180, 190, 1948.

GEOGRAPHICAL DISTRIBUTION. Near Elephant Island; Palmer Archipelago (Discovery); Bellingshausen Sea; Wilhelm II Land (Kluge); off Oates Land (Terra Nova).

The varieties of *Camptoplites bicornis* are compared on p. 443.

The Discovery material from St. 180 agrees very closely with var. *elator* as represented in Kluge's diagnosis and pl. xxix, fig. 4. In the specimens from Sts. 190 and 1948 the upper head-angle of the large long-headed avicularium is more obtuse and may measure as much as  $150^\circ$ .

The ancestrula is described on p. 438 (species 7).

5. *Camptoplites bicornis* var. *quadriavicularis* var.n. Plates X, fig. 3, XII, figs. 1, 2; Figs. 43 A-G, 44 A, B.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, St. WS 871. *Antarctic*: Weddell Quadrant, St. 160.

GEOGRAPHICAL DISTRIBUTION. Off Patagonian Shelf, below 300 m. (Discovery; 34. 11. 12. 10, 85)<sup>1</sup>; Shag Rocks (Discovery).

HOLOTYPE. St. 160, Shag Rocks.

DESCRIPTION. *Main branches* biserial, except at bifurcation where there may be three, or rarely four, series in younger parts of colony, zooecia moderately elongated, tapering fairly uniformly towards proximal end (Fig. 44 A), distal end of zooecium raised, distal corners angular, the inner one sometimes spike-like or bearing a spine.

*Secondary branches* biserial, zooecia shorter than those in main branches and tapering more rapidly, distal corners as in main-branch zooecia.

*Runners* only present where axillary chamber forms rootlet.

*Ovicell* (Fig. 44 B) very shallow and as wide as the zooecium, see pp. 443-444.

*Avicularia* exceptionally long-stalked. Round-headed avicularia all of the same shape, but usually of two sizes, larger ones gigantic; beak long, stout, down-turned; mandible with knob on each side of distal point (Fig. 43 A, B). Large long-headed avicularia big, with strongly curved beak (Fig. 43 D), upper head-angle  $125-135^\circ$ , stalks often of very great length (may be more than four times as long as a typical main-branch zooecium). Small long-headed avicularia as in other varieties of *Camptoplites bicornis* except for presence of oblique calcareous thickening separating beak from head (Fig. 43 C), attached to gymnocyst near proximal border of opesia, leaving small scar when detached. Other three kinds attached more proximally leaving large scars (Fig. 44 A).

REMARKS. The type colony is a bushy tuft 2 in. high (Plate X, fig. 3). In its main characters this form agrees with *C. bicornis*, as understood by Kluge, and is nearest to var. *magna* from which it differs in the shape of the zooecia, particularly those of the secondary branches, in the presence of the thickening in the head of the small long-headed avicularia, in the great length of the avicularian stalks, and in the presence in most specimens of gigantic round-headed avicularia as well as the smaller ones.

<sup>1</sup> Found among material of other species from Challenger St. 320.

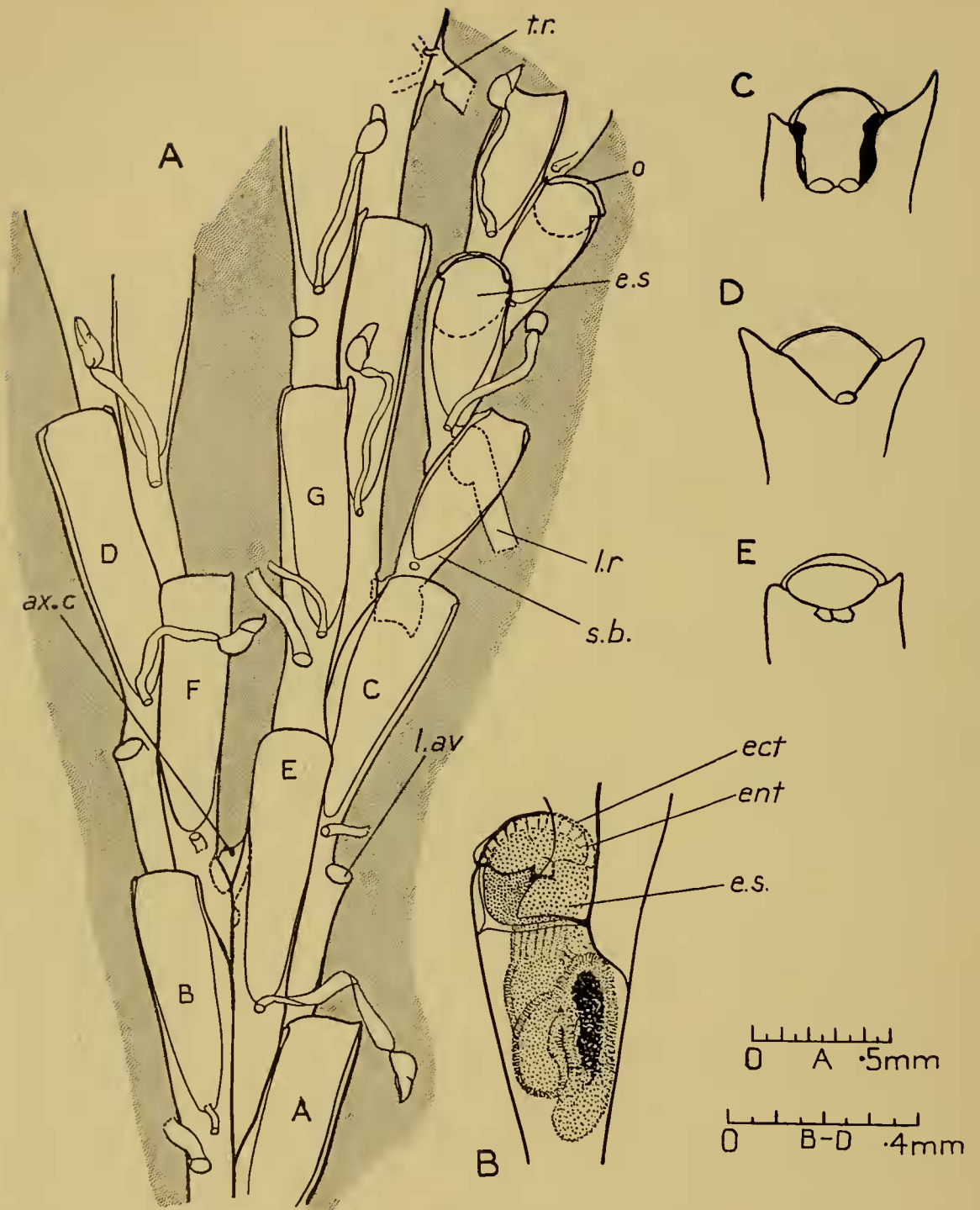


Fig. 44. A, B. *Camptoplites bicornis* var. *quadriavicularis* var.n. St. 160, Shag Rocks. A. Part of the type, with bifurcation lettered according to Harmer's scheme. Several avicularia are represented by scars or broken stalks. B. Fertile zoecium in basal view, showing a complete polypide in the zoecium and an advanced embryo in the embryo-sac. The zoecium preceded a bifurcation and gave rise to two distal zoecia. C. *C. bicornis* var. *compacta* (Kluge). St. 1660, Ross Sea. Distal part of a fertile zoecium in frontal view with soft parts omitted. D. *C. bicornis* var. *elatior* (Kluge). St. 190, Palmer Archipelago. Distal part of fertile zoecium as in Fig. C. E. *C. bicornis* var. *magna* (Kluge). St. 1652, Ross Sea. Distal part of fertile zoecium as in Figs. C and D.

*ax.c.* axillary chamber, *ect.* ectooecium, *ent.* entooecium, *e.s.* embryo sac, *l.av.* scar of large avicularium, *l.r.* lateral rootlet, *o.* ovicell, *s.b.* secondary branch, *t.r.* tip of rootlet from neighbouring branch.

Bifurcations of Harmer's type 4 are sometimes found in the main branches which may thus have as many as four series of zooecia immediately before the bifurcation. The large round-headed avicularia resemble those of *C. giganteus* in their long stout beak, but differ in the thicker spike on the tip of the mandible (cf. Fig. 43 B and I), the relatively straight sclerites (cf. Fig. 43 E and L), and the flatter back of the head of the avicularium as seen in profile (cf. Fig. 43 B and H). The large long-headed avicularia have a more obtuse upper head-angle than those of *C. giganteus* (cf. Fig. 43 D and J). Lateral oval areas as described on p. 339 are to be seen on some zooecia.

The specimen from St. WS 871 (off the Patagonian Shelf) is rather different from the type (cf. Plate XII, figs. 1 and 2). Cross-connexions by rootlets are more common, the branching is more profuse and the zooecia shorter, so that the colony is reticulate and resembles the colonies of the *reticulatus* group, rather than those of typical var. *quadriavicularis*. There are no large round-headed avicularia and the small round-headed avicularia are smaller. The large long-headed avicularia are much shorter and have a thickening where the beak joins the head. In the type a faint trace of such thickening is occasionally visible, but the majority of these avicularia show none at all. A spine is present on the inner distal corner of some zooecia of the Patagonian specimen, whereas the corners in the type may be spike-shaped but are not drawn out into true spines. Despite these differences it is unlikely that the specimen from St. WS 871 represents a distinct variety. Fragmentary material from Challenger St. 320 (which is also off the Patagonian Shelf) is intermediate in character. The branches have the straggling appearance of those of the typical colony, there are few cross-connexions, and both large and small round-headed avicularia are present. On the other hand, the large long-headed avicularia, which are of intermediate size, have a thickening where the beak joins the head, and spines are present on some zooecia.

In the type-specimen, which was taken on 7 February 1927, ovicells are very numerous on both main and secondary branches. Some of these fertile zooecia have the ovicell empty and a large egg in a follicle in the body cavity. A very delicate ovisac can sometimes be detected, the shallow ovicell forming a cap to it. In other zooecia the egg is in various stages of segmentation and occupies the ovisac. In many of the fertile zooecia the polypide is wholly or partially degenerate, but some in which the embryo is at an advanced stage have a complete and normal polypide (Fig. 44 B).

6. *Camptoplites lewaldi* (Kluge). Plate XI, figs. 5, 6; Fig. 45 C, D, G.

*Bugula lewaldi* Kluge, 1914, p. 630, pl. xxx, fig. 3, text-fig. 15.

*Camptoplites lewaldi* Harmer, 1923, p. 300.

STATION DISTRIBUTION. *Antarctic*: Victoria Quadrant, Sts. 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. Wilhelm II Land (Kluge); Ross Sea (National Antarctic Expedition; Discovery).

Secondary branches are present in these specimens, but apparently develop rather late. The Discovery material from St. 1652 comprises some pieces with well-developed fan-shaped secondary branches placed at regular intervals throughout their length

(Plate XI, fig. 6), and others which, although the specimens are more than 2 cm. long, branched, and with as many as six series of zooecia, have few secondary branches, and these only on the proximal parts, and consisting of few zooecia, often of only one (Plate XI, fig. 5). It is thus not surprising that no secondary branches were present in Kluge's material, and the very close agreement with his description in other ways puts the identification beyond doubt.

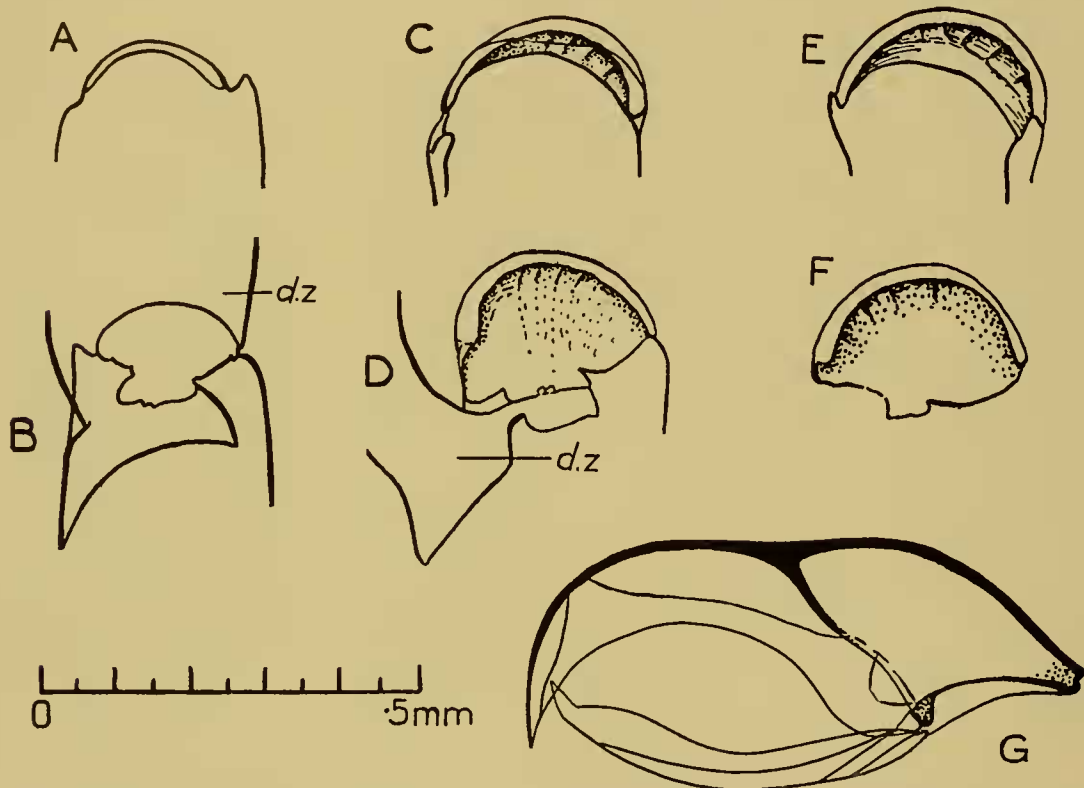


Fig. 45. A, B. *Camptoplites bicornis* var. *magna* (Kluge). St. 1652, Ross Sea. Frontal and basal views of an ovicell on a main branch. C, D. *C. lewaldi* (Kluge). St. 1652, Ross Sea. Frontal and basal views of an ovicell on a secondary branch. In Fig. D note the process connecting the ovicell and the distal zooecium. E, F. *C. giganteus* (Kluge). St. WS 33, South Georgia. Frontal and basal views of an ovicell on a secondary branch. G. *C. lewaldi* (Kluge). St. 1652, Ross Sea. Large avicularium.

*d.z.* distal zooecium.

The axillary chamber forms runners. Ovicells, which were absent in Kluge's material, are present in mine (Fig. 45 C, D). They are of the same general pattern as those of the other species of the *bicornis* group, and are rather markedly reduced (see p. 436). Where the distal zooecium is at an angle to the fertile zooecium, a process from its proximal end connects it with the ovicell (Fig. 45 D). Elsewhere in the same colony the two zooecia are more in line and the proximal end of the distal zooecium lies basally to the ovicell and is connected with it in the usual way.

A specimen of *Camptoplites lewaldi* from St. 1652 has one exceptionally large long-headed avicularium (Fig. 45 G). In it the upper head-angle is more obtuse and the lower more acute than in those of ordinary size. The beak forms a greater proportion

of the total length. The specimen had avicularia of all the usual three kinds as well as this large one.

7. *Camptoplites giganteus* (Kluge). Plate XI, fig. 4; Figs. 43 H-L, 45 E, F.

*Bugula gigantea* Kluge, 1914, p. 630, pl. xxx, fig. 4, text-fig. 16.

*Camptoplites giganteus* Harmer, 1923, p. 300.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, St. WS 33.

GEOGRAPHICAL DISTRIBUTION. South Georgia (Discovery; Shackleton-Rowett Expedition); Wilhelm II Land (Kluge); Ross Sea (Terra Nova).

These specimens agree in most respects with Kluge's description. The two kinds of long-headed avicularia are similar (Fig. 43 J, K), the round-headed avicularia (Fig. 43 H) have the long down-turned beak ("ziemlich langem, senkrecht zur Obermandibel an ihrem freien Ende stehenden, spitzen Auswuchs"), the zooecia of the main branches are as shown in Kluge's figure and the ovicells agree with his description.

The specimens from South Georgia differ from Kluge's in the possession of secondary branches (Plate XI, fig. 4). These when fully formed are much branched, spreading out fanwise. The material from Ross Sea consists of small fragments only and does not show secondary branches. In all my material the axillary chamber forms runners.

The round-headed avicularia from both localities vary a little in size, but form a graded series rather than two groups as in *Camptoplites bicornis* var. *quadriavicularis*. They are all larger than those of *C. lewaldei* (cf. Plate XI, figs. 4, 5 and 6). Kluge does not mention this and it seems possible that his specimens had smaller avicularia.

This species is closely allied to *C. bicornis*. Its ovicells (Fig. 45 E, F) are rather less reduced, being intermediate between those of *C. lewaldei* and *C. tricornis*.

8. *Camptoplites tricornis* (Waters). Plate XIII, fig. 3; Fig. 46 B, C.

*Bugula tricornis* Waters, 1904, p. 23, pl. i, fig. 9 a-d, pl. viii, fig. 3; Livingstone, 1928, p. 27 (references).

*Camptoplites tricornis* Harmer, 1923, p. 300.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 27, 42, 156, 160, WS 27, WS 33, WS 42, MS 68; Victoria Quadrant, Sts. 1651, 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia; Shag Rocks (Discovery); Bellingshausen Sea (Waters); Adelie Land (Livingstone); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition; Terra Nova; Discovery; 30.3.5.1-4).

After examination of the Belgica collection Kluge (1914, p. 625) described this strongly characterized species under the name introduced by Waters. Waters's figures are not characteristic, and in particular do not show the median spine, but two peculiarities of the species are recognizable, namely, the lateral proximal points on the large avicularia, and the unusual position of the lateral rootlet-chamber (Fig. 46 C). These chambers, from which the lateral rootlets and the secondary branches both originate, are not in the angle between two successive marginal zooecia, as in other species, but are on the side of one zooecium where it bends upwards, as figured by Waters and described by Kluge. Both the axillary and the lateral chambers (Fig.

46 B, C) are without runners. The rootlets may terminate in a branched disk. The smaller avicularia have blunt mandibles.

The colonies vary in general appearance. Some are profusely branched, with many secondary branches and rootlets, and present a dense mat-like appearance (Plate IX, fig. 3). Others, such as the colony from St. 1651, are more lax in growth. The material from St. 1660 includes some specimens with long straight zooecia forming broad strap-like branches with as many as twelve series of zooecia. Other specimens from the same station have shorter, less straight, zooecia, and narrower branches. There is also variation in the spines which are sometimes very stout, the median distal one being particularly large. This is well seen, for example, in the material from St. TN 194.

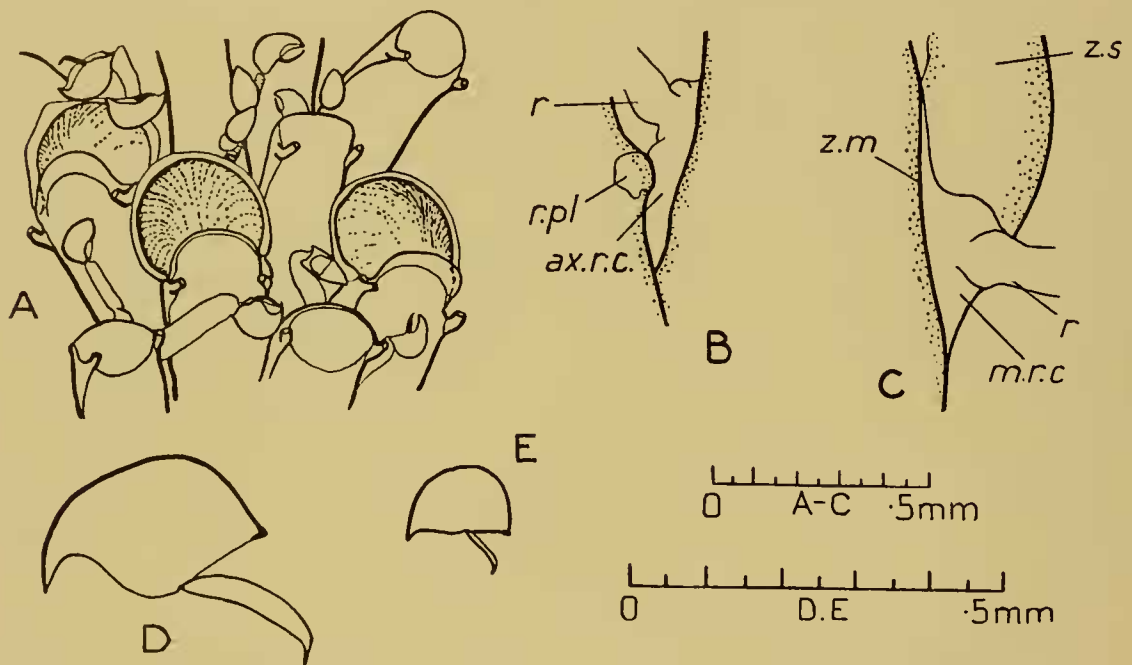


Fig. 46. A. *Camptoplites angustus* (Kluge). St. TN 340, Ross Sea. Part of a secondary branch. Three zooecia have their opercula open. B, C. *C. tricornis* (Waters). 30.3.5.4. Ross Sea. B. Axillary rootlet-chamber. C. Marginal rootlet-chamber, with rootlet and base of secondary branch. D, E. *C. angustus* (Kluge). St. TN 339, Ross Sea. Avicularia.

*ax.r.c.* axillary rootlet-chamber, *m.r.c.* marginal rootlet-chamber, *r.* rootlet, *r.pl.* rosette-plate, *z.m.* wall of marginal zooecium of main branch, *z.s.* zooecium of secondary branch.

#### 9. *Camptoplites abyssicolus* (Kluge).

*Bugula abyssicola* Kluge, 1914, p. 632, text-fig. 18.

*Camptoplites abyssicolus* Harmer, 1923, p. 300.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Southern Ocean, 2450 m. (Kluge).

I have seen no specimen of this species.

#### 10. *Camptoplites angustus* (Kluge). Plate XII, fig. 3; Fig. 46 A, D, E.

*Bugula angusta* Kluge, 1914, p. 631, pl. xxx, fig. 5, text-fig. 17.

*Camptoplites angustus* Harmer 1923, p. 300.



STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 167, 181<sup>1</sup> and Deception Island; Victoria Quadrant, Sts. 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. South Orkney Islands; South Shetland Islands (Discovery); Palmer Archipelago<sup>1</sup> (Discovery); Bellingshausen Sea? (Waters); Wilhelm II Land (Kluge); Oates Land (Terra Nova); Ross Sea (National Antarctic Expedition; Terra Nova; Discovery).

The shape of the colony, with straight main branches, consisting of several series of zooecia, and giving off fan-shaped secondary branches at fairly regular intervals on each side, is characteristic (Plate XII, fig. 3). There is commonly a secondary branch at the bifurcation, arising from the axillary chamber. Ovicells (Fig. 46 A) are numerous on the secondary branches. They are like those of *Camptoplites abyssicolus* (Kluge, 1914, text-fig. 18, p. 632), but are less reduced.

The avicularia are very variable in size so that they do not obviously represent two kinds, but two types, distinguished on p. 435, are nevertheless present (Fig. 46 D, E). My specimens agree so well with Kluge's account in other respects that I have no hesitation in making the identification, despite his statement that the avicularia are all of one form though varying in size.

Ancestrulae which appear to belong to this species are described on p. 438 (species 6).

11. *Camptoplites retiformis* (Kluge). Plate IX, fig. 3; Figs. 47 A-H, 48 A, B.

*Bugula retiformis* Kluge, 1914, p. 629, pl. xxviii, fig. 5, text-fig. 14; Livingstone, 1928, p. 27.

*Camptoplites retiformis* Harmer, 1923, p. 300.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 27, 39, 42, 156, 181, 187, 190, 1948, WS 33, WS 42, MS 71; Victoria Quadrant, Sts. 1652, 1660.

GEOGRAPHICAL DISTRIBUTION. South Georgia; near Elephant Island; Palmer Archipelago (Discovery); Wilhelm II Land (Kluge); Queen Mary Land (Livingstone); Oates Land (Terra Nova); Ross Sea (Terra Nova; Discovery).

The appearance of the ovicells differs markedly with age. When first formed the entoecium is radially striated, but a reticulate sculpture is gradually laid down, eventually becoming very conspicuous. This is particularly well seen in a large colony from St. WS 42 (South Georgia) which has two fertile zones (Plate IX, fig. 3). In the younger zone there is a gradation from incompletely formed ovicells through complete ones with radial striation to those in which the reticulation has begun to appear, but is faint and delicate (Fig. 48 A). In the second zone the full sculpture is present (Fig. 48 B). The fertile zooecia of both zones bear the long, stout spines on one or both distal corners. The spines on the non-fertile zooecia are also directed frontally, but are short and slender.

Rosette-plates are present in the outer lateral walls of the zooecia in the marginal series, and the tips of the runners and of the lateral rootlets tend to be in contact with them. In Fig. 47 H the tips of both runners of the axillary chamber and of three of the four branches of the lateral rootlet end in this way. The connexion is so frequent that it seems unlikely that it is accidental. Sometimes, too, the ends of rootlets that have not run directly to a rosette-plate have turned and grown along the edge of the colony till

<sup>1</sup> Only represented by the young colonies described on p. 438, species 5, no adult colony taken.

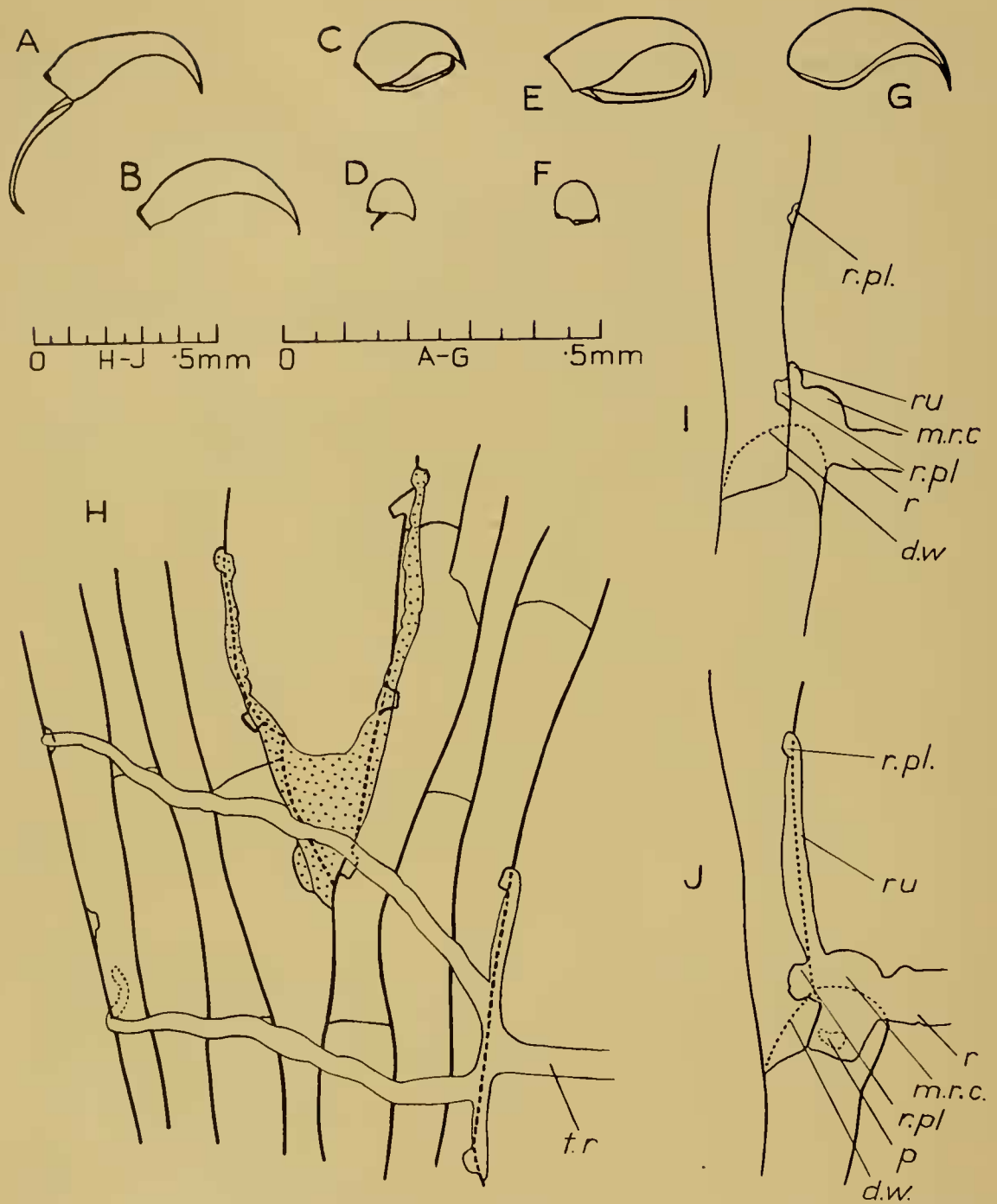


Fig. 47. A-G. Avicularia of *Camptoplites retiformis* (Kluge). A, B. St. WS 42, South Georgia. Mandible omitted in Fig. B. C, D. St. 187, Palmer Archipelago. E, F. St. 156, South Georgia. G. St. TN 339, Ross Sea. Mandible omitted. H. *C. retiformis* (Kluge). St. 156, South Georgia. Basal view of a bifurcation and the tip of a rootlet from the next branch. I, J. *C. latus* var. *aspera* var.n. St. 45, South Georgia. Lateral rootlet-chamber and parts of adjacent zoecia, basal view. I. Early stage near tip of branch. J. From more proximal part of the same branch showing more developed runner. *d.w.* distal wall of zoecium, *m.r.c.* marginal rootlet-chamber, *p.* pore connecting rootlet-chamber and zoecium, *r.* rootlet, *r.pl.* rosette-plate, *ru.* runner, *t.r.* tip of rootlet from next branch. Axillary chamber and runners stippled.

they have come to one, or (as in the fourth branch in the figure) have grown rather deviously towards one. It is difficult to see whether there is any continuity of living substance through the rosette-plate, but where the tissues are abundant their arrangement suggests that there is. Similar connexions of rootlets and runners with rosette-plates have been seen in *Camptoplites latus* (Fig. 47 I, J), *C. reticulatus*, *C. asymmetricus*, *C. atlanticus*, and *C. rectilinearis*. In *C. atlanticus* the attaching rootlets of young colonies are connected with the rosette plates of the supporting colony in the same way (Fig. 40).

The small avicularia are short in proportion to their height, with the front and back of the head almost parallel, and the lower head-angle about  $90^\circ$  (Fig. 47 D, F). They vary in size within the colony, some being very small indeed.

The large avicularia vary in size and shape (Fig. 47 A–G) within the species as understood here, those from South Georgia (Fig. 47 A, B, E) being more slender and usually, but not always (Fig. 47 B), flatter dorsally than those from the Palmer Archipelago and Ross Sea. It is perhaps worth noticing that the large avicularia of *C. asymmetricus* (Fig. 55 C, E), particularly of the South Georgian specimen (Fig. 55 E) are more slender and less curved than those of *C. areolatus*, the related species from further south (Fig. 55 A), and that the large avicularia of the South Georgian *C. latus* var. *aspera* differ similarly from those of typical *C. latus* and *C. latus* var. *striata* which are found in more southerly Antarctic localities (cf. Kluge, 1914, text-fig. 20, and my Fig. 49 E, F). In a specimen of *C. retiformis* from St. 190 (Palmer Archipelago) the large avicularia are unusually large and numerous. This specimen has no ovicells.

In the specimens from the Ross Sea region and the Palmer Archipelago the ovicells are usually rather narrow in proportion to their height, and the meshes of their reticulate sculpture are large and regular (Fig. 48 B). In the specimens from South Georgia they are more variable, some tending to be broader with less regular reticulation, though others are more typical. In these ways the South Georgian ovicells approach those of var. *tenuispina* (Fig. 48 C), but they always show the rather regular reticulation of the typical form over part of their surface; the sculpture, when complete, is thick, as in the typical form; and there are stout spines on the fertile zooecia.

Among the specimens from St. 1660 (Ross Sea) there are some with broad branches composed of as many as fifteen series of zooecia.

The ancestrula of *C. retiformis* is described above, p. 438 (species 5).

Calvet's figure of his supposed *C. reticulatus* (1909, pl. i, fig. 3) might well represent *C. retiformis*, but as he attributes it without comment to a biserial species, it is to be presumed that his specimens were biserial. They may have belonged to *C. areolatus* (see p. 465).

## 12. *Camptoplites retiformis* var. *tenuispina* var.n. Fig. 48 C, D, E.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 195, 363, 371.

GEOGRAPHICAL DISTRIBUTION. South Sandwich Islands; South Shetland Islands (Discovery).

HOLOTYPE. St. 195, South Shetland Islands.

The specimens from the South Shetland and South Sandwich Islands appear to represent a distinct variety, differing from the typical form in the ovicells and in the

absence of any distinction between the spines of the fertile and non-fertile zones, the spines all being slender, and usually short, as compared with those of the typical form. The ovicells are broader than is usual in the typical form and differ in their sculpture (Fig. 48 C). A reticulate phase succeeds the radially striated phase, but its lines do not

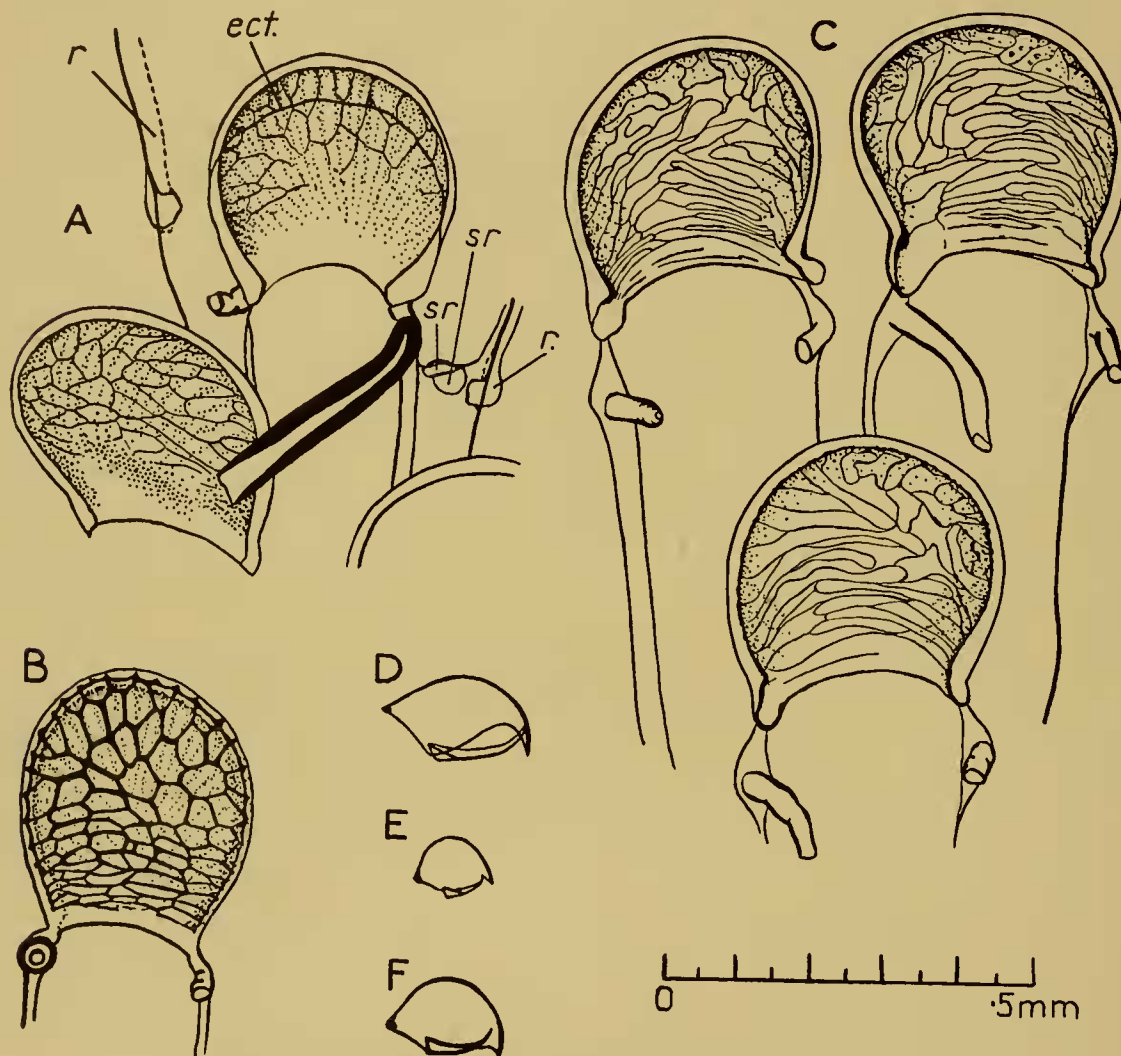


Fig. 48. A, B. *Camptoplites retiformis* (Kluge). St. WS 42, South Georgia. A. Ovicells from younger fertile zone showing stages in the development of the reticulation. One of the ovicells is seen obliquely. B. Fully calcified ovicell from the older fertile zone of the same colony. The spines are seen end-on. C. *C. retiformis* var. *tenuispina* var.n. St. 195, South Shetland Islands. Three zoecia with fully formed ovicells. D, E. *C. retiformis* var. *tenuispina* var.n. St. 363, South Sandwich Islands. Avicularia. F. *C. latus* (Kluge). St. TN 316, McMurdo Sound. Small avicularium for comparison with Fig. E. *ect.* edge of calcareous part of ectooecium, *r.* tip of a rootlet from another branch, *sr.* avicularian scar.

become generally and uniformly thickened as in the typical form. In older ovicells nodular thickenings appear on the lines and may be accompanied by punctate sculpture in the meshes. The figure shows the first indications of these thickenings. The pattern of the reticulation is variable. The meshes may be fairly regular and more or less hexa-

gonal as in the typical form, irregular (suggesting a jig-saw puzzle), or very narrow and elongated so that the whole pattern is reminiscent of a finger-print.

The small avicularia are a little longer in proportion to their height than those of the typical form (cf. Figs. 47 D, F and 48 E), and may be a little thickened and projecting where they are attached to the stalk. In these ways they approach those of *Camptoplites*

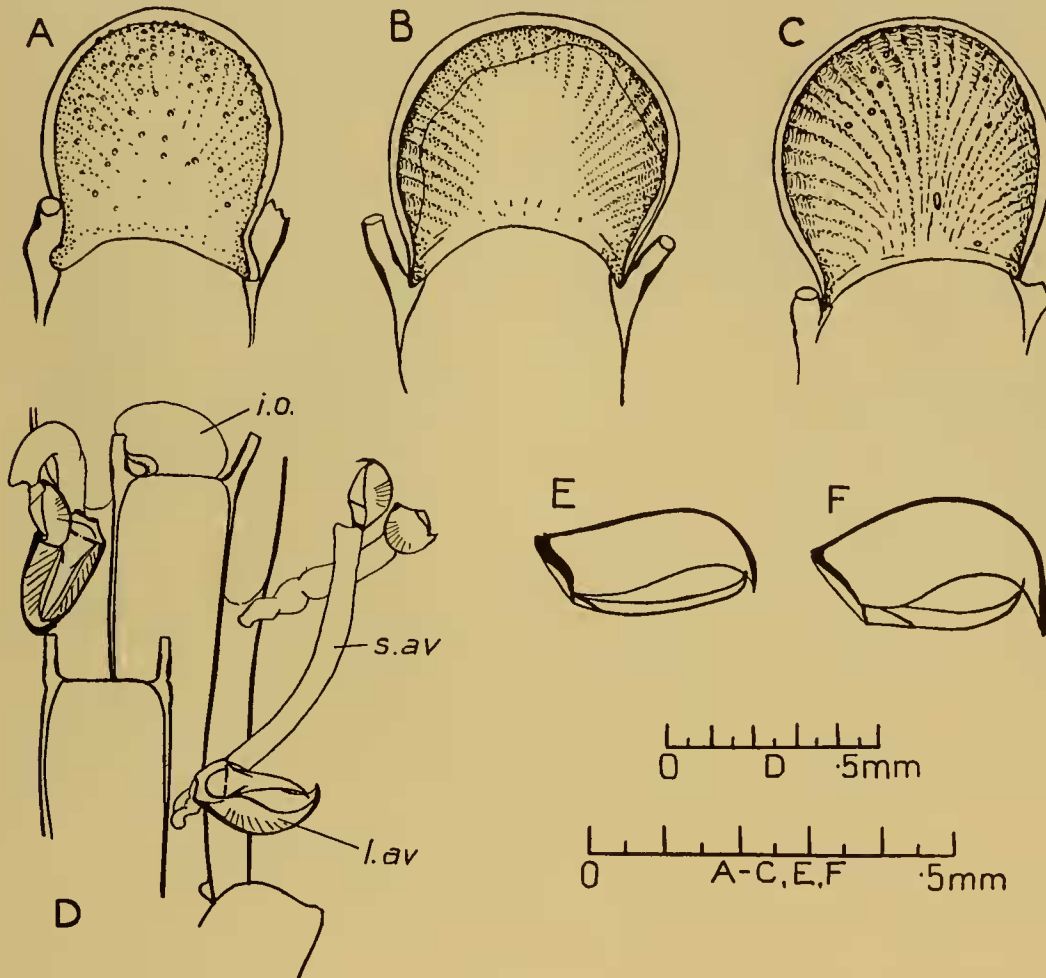


Fig. 49. A. *Camptoplites latus* (Kluge). St. TN 316, McMurdo Sound. Ovicell. B-D. *C. latus* var. *striata* var.n. St. 190, Palmer Archipelago. B. Incompletely calcified ovicell. C. Ovicell from 3rd fertile zone showing more advanced calcification. D. Triserial branch showing large avicularia on both inner and outer zooecia. E. *C. latus* var. *aspera* var.n. St. WS 42, South Georgia. Large avicularium. F. *C. latus* var. *striata* var.n. St. 190, Palmer Archipelago. Large avicularium.

*i.o.* incipient ovicell, *l.av.* large avicularium (short stalked), *s.av.* small avicularium.

*latus* (Fig. 48 F), but the lower head-angle is always less acute. The length of the downturned beak is variable. The large avicularia are uncommon. The ovicells much resemble some of those of *C. latus* var. *aspera* (Fig. 50 B), but have not been seen to proceed to the thickened roughened stage in which the reticulation is obliterated. In other respects this form resembles *C. retiformis* rather than *C. latus*.

13. *Camptoplites latus* (Kluge). Figs. 48 F, 49 A.

*Bugula lata* Kluge, 1914, p. 634, text-fig. 20.

*Camptoplites latus*, 1923, p. 300.

STATION DISTRIBUTION. *Antarctic*: Victoria Quadrant, St. 1652.

GEOGRAPHICAL DISTRIBUTION. Wilhelm II Land (Kluge); Ross Sea (Terra Nova; Discovery).

These specimens agree very closely with Kluge's account of *Camptoplites latus*. The radial sculpture, shown by him, is present in young ovicells, but later a punctate sculpture, consisting of small, widely spaced dots, is superimposed (Fig. 49 A).

*C. latus* is distinguished from *C. retiformis* by the shape of the zooecia, by the sculpture of the fully calcified ovicells, by the direction of the spines, by the exceedingly short stalks of the large avicularia, and by the acute lower head-angle of the small ones (cf. Figs. 47 D, F and 48 F). The small avicularia are less variable in size, the very small ones found in *C. retiformis* being absent in *C. latus*. Kluge's figures (fig. 20 and pl. xxviii, fig. 5) show most of the points of contrast very clearly.

14. *Camptoplites latus* var. *striata* var.n. Fig. 49 B-D, F.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 190, 599.

GEOGRAPHICAL DISTRIBUTION. Palmer Archipelago; Adelaide Island (Discovery).

HOLOTYPE. St. 190, Palmer Archipelago.

This variety differs from *Camptoplites latus* in its ovicells and large avicularia. The ovicells are broader and show more marked radial striation, appearing almost fluted, and there is much less change with age (Fig. 49 B, C). In a colony with three fertile zones the fluting is the conspicuous sculpture of all the ovicells. A very faint reticulation can be discerned on a few ovicells of the two older zones, and also occasional dots, like those of typical *C. latus*, but this secondary sculpture is extremely inconspicuous. Although most of the ovicells in the second zone contain eggs or embryos, calcification of the ectooecium is only completed in the third zone.

The large avicularia (Fig. 49 F), which are short-stalked as in typical *C. latus*, are longer headed and are commonly found on the marginal zooecia (Fig. 49 D), whereas those of *C. latus* are only found on zooecia of the inner rows. In the shape of the zooecia and small avicularia, and in the position of the spines, var. *striata* resembles *C. latus*.

15. *Camptoplites latus* var. *aspera* var.n. Plate IX, fig. 4; Figs. 47 I, J, 49 E, 50 A-C.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, Sts. 45, 140, 149, WS 42.

GEOGRAPHICAL DISTRIBUTION. South Georgia (Discovery).

HOLOTYPE. St. WS 42.

This variety differs from *Camptoplites latus* in its ovicells and large avicularia, and in its spines, some of which are directed obliquely forwards while others point distally as in *C. latus*. When first formed the ovicells show distinct radial striation, but reticulation soon appears and gradually becomes very distinct, though not heavy as in *C. retiformis* (Fig. 50 B, C). Subsequently this reticulation is almost completely obliterated by a general thickening and roughening of the calcification (Fig. 50 A). The reticulation may

be of the irregular, finger-print type (Fig. 50 B), also found in *C. retiformis* var. *tenuispina*, or more regular (Fig. 50 C) as in typical *C. retiformis*. Although approaching *C. retiformis* in this way, the variety is distinguished from it, and resembles *C. latus*, in the shape of the zooecia and of the small avicularia, and in the short stalks of the large avicularia (Fig. 50 A). In the large size and marginal position of the large avicularia, and the broader shape of the ovicells it resembles var. *striata*, but it differs from it in

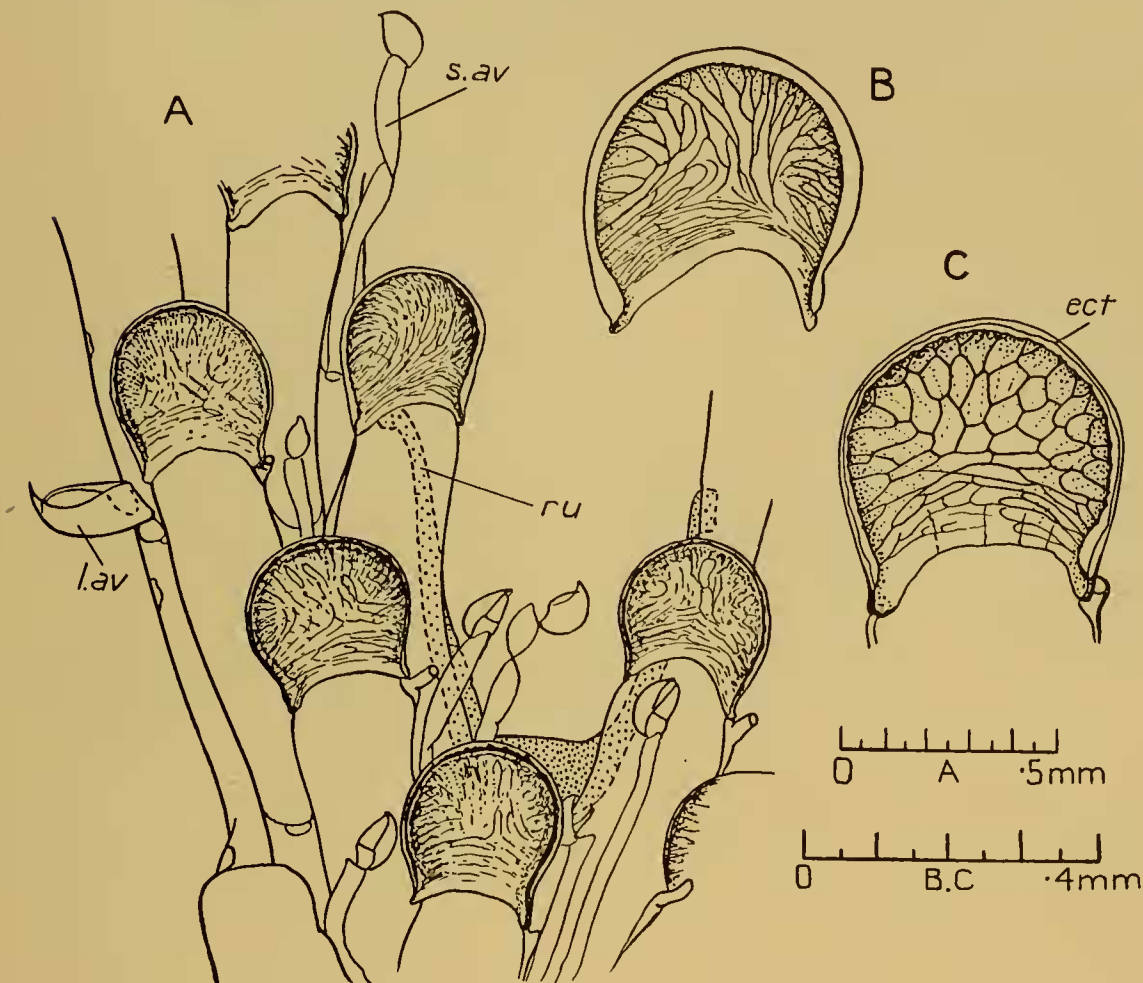


Fig. 50. *Camptoplites latus* var. *aspera* var.n. A, B. St. WS 42, South Georgia. A. Showing ovicells at a moderately advanced stage in the obliteration of the reticulation. Axillary chamber and runners stippled. Some zooecia have one small avicularium, others two. B. Ovicell from same colony showing an earlier stage of calcification. Slightly oblique view. C. St. 140, South Georgia. Ovicell with more regular reticulation.

*ect.* edge of calcareous part of ectoecium, *l.av.* marginal, short-stalked, large avicularium, *ru.* runner, *s.av.* long-stalked small avicularium.

the shape of the large avicularia which are flatter dorsally and longer, as well as in the direction of the spines and the sculpture of the ovicells.

The ovicells do not appear to be arranged in zones, but, as they were described from a longer branch than the three-zoned branches of var. *striata*, bearing ovicells through-

out its length (Plate IX, fig. 4), and as marked differences in calcification were observed, they may be supposed to give a fair idea of the phases of calcification.

Fragments of a species of *Camptoplites*, judged from the shape of its zooecia and small avicularia to be one of the forms of *C. latus*, were taken by the 'Quest' at South Georgia (23.12.1.34, 36). Unfortunately, there are no large avicularia and no ovicells, but the small spines are directed frontally in some zooecia, distally in others, as in var. *aspera*, the only form of the species known from South Georgia. The fragments show an axillary rootlet with an elaborately branched terminal disk, and also the formation of a branch by regeneration from the distal part of a single damaged zooecium.

16. *Camptoplites atlanticus* sp.n. Figs. 40, 51 A-C.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. WS 93, WS 231, WS 773, WS 824.

GEOGRAPHICAL DISTRIBUTION. Patagonian Shelf, and off the shelf down to 293 m. (Discovery).

HOLOTYPE. St. WS 773.

DESCRIPTION. *Colony* with two to seven (or more?) series of zooecia, no secondary branches.

*Rootlets* arising from lateral and axillary chambers, both with runners (Fig. 51 A). Axillary chambers without rootlets also present. Cross-connexions common.

*Zooecia* with their distal ends raised and, in the marginal zooecia, turning away from the median line of the branch.

*Spines* absent.

*Avicularia* (Fig. 51 B) all of one kind, longer than high, the lower head-angle about 90°.

*Ovicells* (Fig. 51 C) about as wide as high with pronounced radial striation or fluting which shows no tendency to be superseded by other sculpture.

*Ancestrula* (Fig. 40) vase-shaped, with long opesia and short stalk, attached by roots, spineless (species 2, p. 439).

REMARKS. This species is related to *Camptoplites latus*. It differs in the complete absence of spines throughout the colony, in the avicularia which are all of one kind and differ in shape from those found in *C. latus*, and in the ovicells in which the original radial striation is pronounced and, as far as the evidence goes, permanent. The avicularia are longer in proportion to their height than the small avicularia of *C. latus*, and the lower head-angle, which is acute in *C. latus*, measures about 90° (cf. Figs. 48 F and 51 B).

Three young colonies are attached to the type specimen. Each consists of an ancestrula and a few zooecia. The complete absence of spines even on these young colonies is remarkable. Avicularia, of typical shape, are present on the second and subsequent zooecia. The stalk of the ancestrula is very short as compared with other known ancestrulae of *Camptoplites*, and ends in two to four roots which may be symmetrically arranged, as in the figured specimen, or may be more irregular. Their tips, like those of the ordinary runners and rootlets of the adult colony, tend to be in contact with rosette-plates, but here they are the rosette-plates of the supporting colony. The connexion of a rootlet of one colony with the rosette-plate of another colony seems



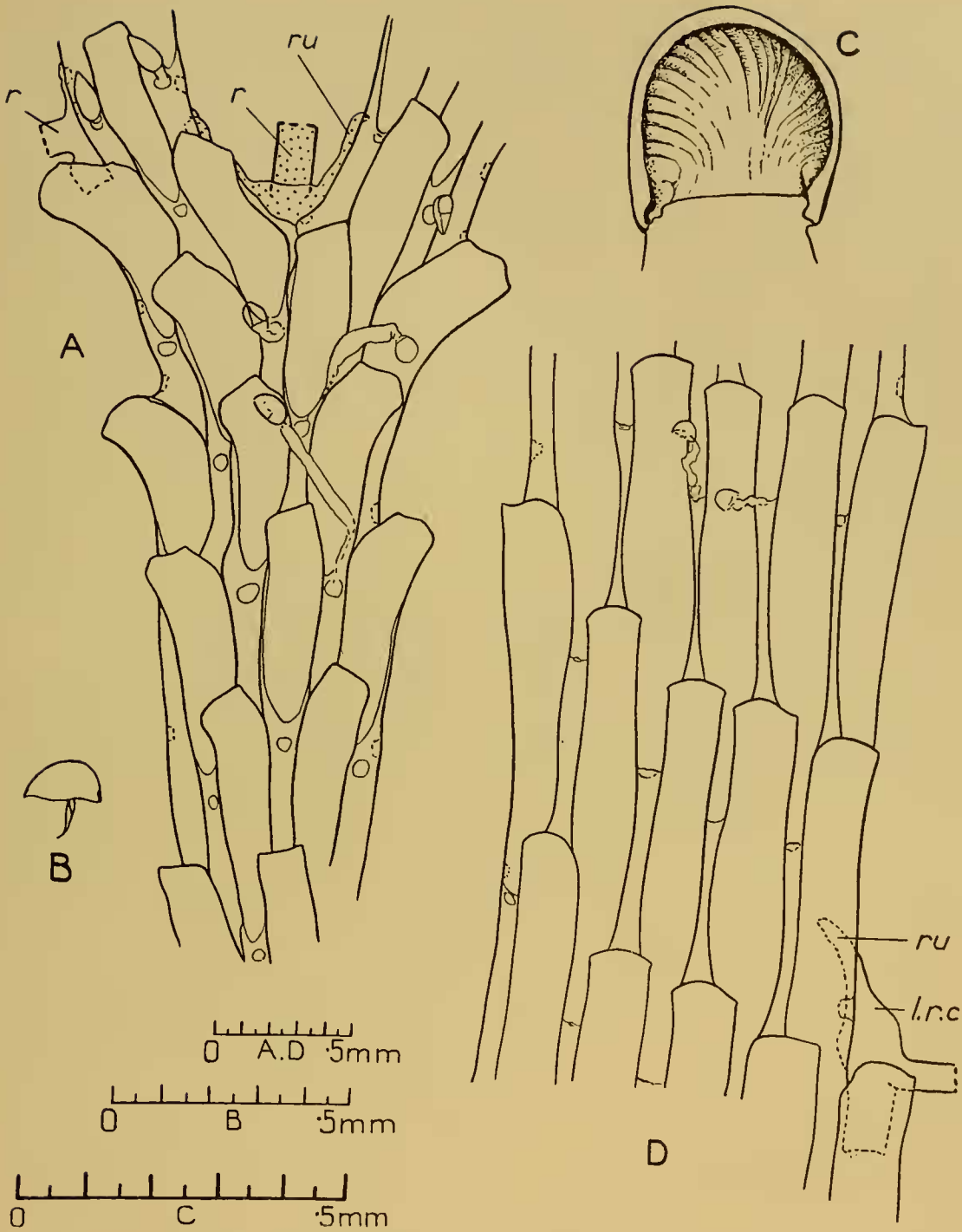


Fig. 51. A-C. *Camptoplites atlanticus* sp.n. St WS 773, off Patagonian Shelf. A. Part of zoarium. The proximal part of some of the avicularian stalks is obscure, but their place of attachment proximally to the opesia is very clear. Axillary chamber, with runners and rootlet, stippled. B. Avicularium. C. Ovicell. D. *C. rectilinearis* sp.n. St. TN 314, McMurdo Sound. Non-fertile zoecia. Most of the avicularia lost or broken. Avicularian scar at edge of gymnocyst of most zoecia.

*l.r.c.* lateral rootlet-chamber, *r.* rootlet, *ru.* runner.

remarkable. In the figured specimen three of the four roots end in contact with rosette-plates, and the fourth is apparently only prevented because two rootlets of the supporting colony are in the way. The seven young colonies examined have amongst them ten roots ending in contact with rosette-plates.

17. *Camptoplites rectilinearis* sp.n. Plate XII, fig. 4; Figs. 51 D, 52 A-D.

STATION DISTRIBUTION. *Antarctic*: Victoria Quadrant, St. 1660.

GEOGRAPHICAL DISTRIBUTION. Ross Sea (Terra Nova, Sts. TN 314, TN 339; Discovery).

HOLOTYPE. St. TN 339.

DESCRIPTION. *Colony* (Plate XII, fig. 4) consisting of long straight branches with many series of zooecia (eleven counted in some branches).

*Rootlets* arising from lateral and axillary chambers with runners, axillary rootlet arising from frontal or distal surface of chamber and projecting frontally (Fig. 52 A).

*Zooecia* very long and narrow (Fig. 51 D), with nearly straight sides, borders of aperture overlapping neighbouring zooecia very slightly. Marginal zooecia usually with outer distal corner pointed.

*Spines* present on some fertile zooecia, slender and directed frontally, otherwise absent.

*Avicularia* of two kinds both with moderate stalks (Figs. 52 A-C). Small ones round-headed with lower head-angle about  $90^\circ$ . Larger ones long-headed with lower head-angle acute, not so large as those of *Camptoplites retiformis* and *C. latus*.

*Ovicells* usually longer than wide, entoecium radially striated when young (Fig. 52 A), a slight roughening or punctate sculpture being superimposed later, ectoecium mostly uncalcified, its only frontal calcification (if any) being in its distal part (Fig. 52 D).

REMARKS. In basal view the lateral walls of the zooecia are nearly parallel throughout their length. In frontal view (Fig. 51 D) the straight-sidedness of the zooecia is less conspicuous because the borders of the aperture slightly overlap the neighbouring zooecia. The basal surface commonly bears fine transverse striations, which appear curved as they follow the contour of the wall, but these are sometimes, though less frequently, seen in related species.

It might be thought that the direction of the rootlets (in which *C. rectilinearis* agrees with *C. reticulatus* and *C. areolatus*) would depend on the position in which the particular colony was growing, but it is so consistent in the material of *Camptoplites* examined by me that I regard it as a specific character.

Branches with as many series of zooecia are found in *C. retiformis* and *C. latus*, and long narrow zooecia are sometimes seen, particularly in *C. retiformis*, but they are not usual in these species. In the direction (but not the distribution nor the size) of the spines, in the shape of the avicularia, and in the long stalks of the large avicularia, *C. rectilinearis* resembles *C. retiformis*. The ovicells are larger than those of either *C. retiformis* or *C. latus*, and differ from them in sculpture.

18. *Camptoplites reticulatus* (Busk). Figs. 53 C, 55 G, H.

*Bugula reticulata* Busk, 1881, p. 12, pl. i, figs. 7, 7a; 1884 (part), p. 40, pl. viii, figs. 3, 3a, 3b.

*Camptoplites reticulatus* Harmer, 1923, p. 300.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Off Valparaiso, 3953 m.; off Crozet Islands, 2928 m. (Busk).

Busk's figures were drawn from the material from Challenger St. 147 (Crozet Islands) which must be taken as the type. The slide figured by Busk is no. 99.7.1.284. Ovicells are abundant in this material, but were not figured. They are all at an advanced stage of development and no radial phase has been seen, the sculpture being coarsely punctate or papillate (Fig. 53 C). Busk only mentions one kind of avicularium, but the two types commonly found in the *reticulatus* group of *Camptoplites* (see p. 435) are present (Fig. 55 G, H).

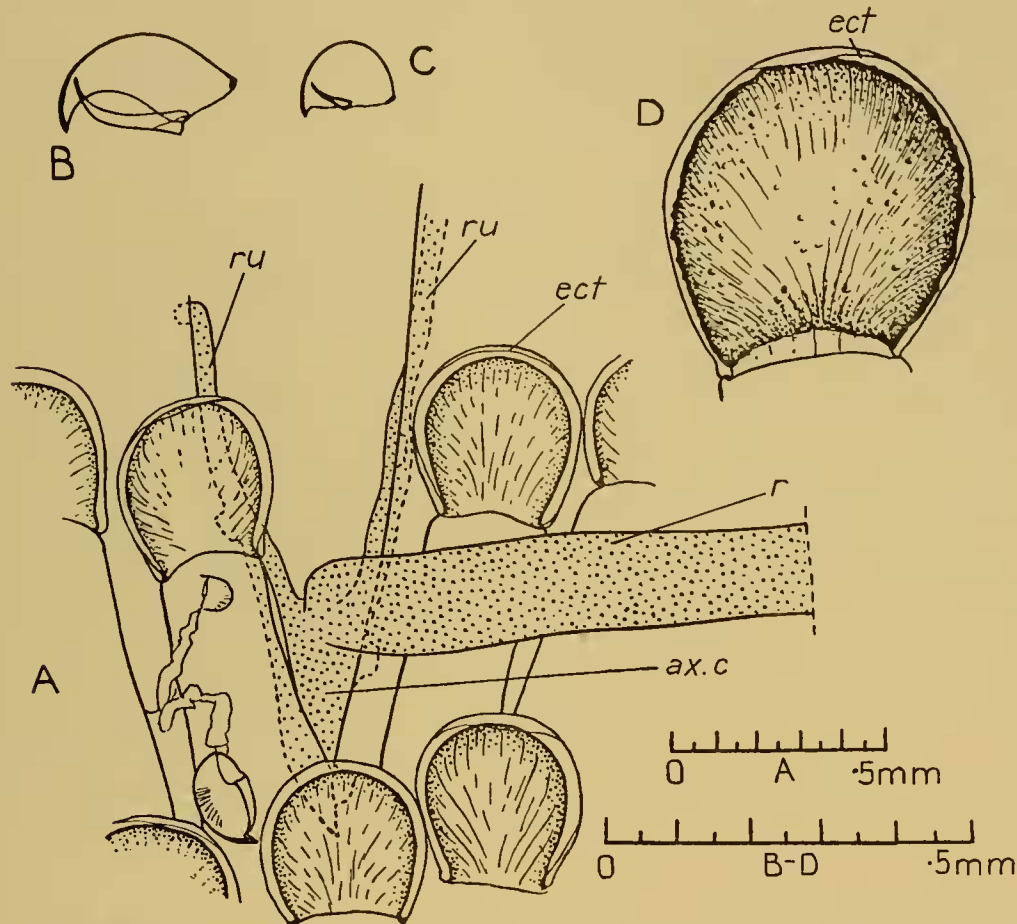


Fig. 52. *Camptoplites rectilinearis* sp.n. A. St. TN 339, Ross Sea. Bifurcation showing axillary chamber with runners and frontally directed rootlet. Ovicells young. B, C. Avicularia from same colony as Fig. A. D. St. TN 314, McMurdo Sound. Older ovicell.

*ax.c.* axillary chamber, *ect.* edge of calcareous part of ectoecium, *r.* rootlet, *ru.* runner. Axillary chamber, runners and rootlet stippled.

The specimen from Challenger St. 299 (off Valparaiso, 87.12.9.185) has neither spines nor ovicells. The specimens from Challenger St. 320 and St. 308 (see footnote, p. 466) belong to a distinct species described below as *C. asymmetricus*.

Busk distinguished a variety, *C. reticulatus* var. *unicornis*, by the presence of "a tubular cylindrical spine arising from the back near the top", but such spines are also present in

the type material of the species. The spine was described by Busk as "probably only a modified or undeveloped connecting-tube", but it appears to be a true spine, and has not the chamber and runner found at the point of origin of the connecting tubes or rootlets. The species and the variety also resemble each other in the axillary rootlets which issue frontally. There is, however, a distinct difference in the shape of the zooecia which are more tapering in the variety, giving its branches a more sinuous outline. Busk figured an ovicell of var. *unicornis*, but shows no sculpture, and no complete ovicell is now to be found in his material of the variety.

As suggested by Kluge, it seems more probable that the Antarctic form, called *Bugula reticulata* by Waters (1904, p. 22), belonged to *C. areolatus* Kluge than to true *C. reticulatus*. *C. reticulatus* (Calvet) may also belong to *C. areolatus*, see pp. 455, 466. It is certainly distinct from *C. reticulatus* (Busk). For a discussion of *Bugula reticulata* var. *spinosa* Waters, see p. 441.

19. *Camptoplites lunatus* Harmer. Fig. 53 A, B.

*Camptoplites lunatus* Harmer, 1926, p. 452, pl. xxxiv, figs. 5-8.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. South-west of Timor, 2050 m. (Harmer); off Crozet Islands, 2928 m. (1940.7.8.1).

A colony of this species, found unnamed among material from Challenger St. 147 (Crozet Islands), agrees very closely with Harmer's description. The lateral rootlets, which spring from chambers without runners, form cross-connexions making the colony reticulate.

The zooecia are rather long and slender. The expanded part bearing the opesia forms about half their length and the narrow, tubular, proximal half is not conspicuous. The zooecia have two rather stout spines. One is placed distally on the basal surface in the mid-line of the operculum which is oblique in non-fertile zooecia, matching the obliquity of the distal end of the zooecium. The other spine is on the outer distal corner, directed frontally. Spines in these positions are shown in Harmer's figures. The forward direction of the outer distal corner and its spine is evidently natural and is the cause of the tendency to unnatural inward folding of the corner noticed by Harmer. The spines have a flexible zone at their base. As noted by Harmer the distal spine may be replaced by a rootlet-chamber.

Very large, delicately calcified ovicells are present, and are the largest known in *Camptoplites* (cf. Fig. 53 A, B with Figs. 48 A-C, 49 A-C, 50 B, C, 51 C, 52 D, 53 C, D, 54 B, D, all drawn to the same scale). The entoecium bears radial sculpture with fine transverse striations and has an out-turned lip. The greater part of the basal surface of the ovicells is free from the distal zooecium and is fluted like the frontal surface. The outer distal spine is present on fertile zooecia. The basal spine may also be present and underlies the ovicell.

The thin axillary rootlets of *C. lunatus*, adhering to the basal surface of the branch, are in striking contrast to the stout, free axillary rootlets of other species of *Camptoplites*.

The Challenger specimen was only discovered after the portion of the type-specimen deposited in the British Museum had been despatched to a place of safety, and the main

part of the type-colony at Amsterdam was also not available for examination owing to the war. The British Museum type-specimen had, however, been examined several years before during the preparation of the rest of this account of *Camptoplites*.

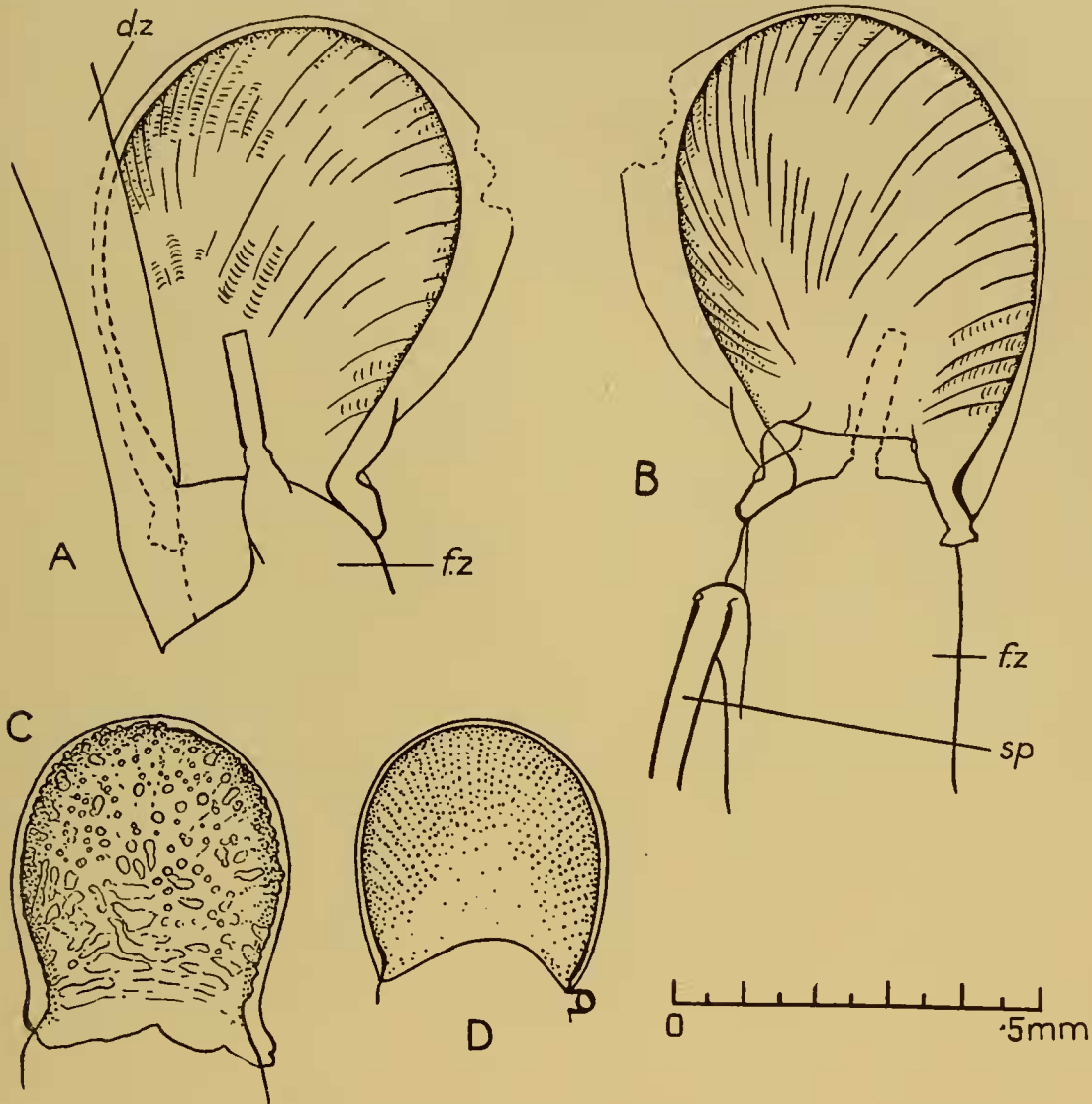


Fig. 53. A, B. *Camptoplites lunatus* Harmer. 1940.7.8.1. Challenger St. 147, off Crozet Islands. The same ovicell in oblique basal and frontal views. There is a break in the ectooecium. C. *C. reticulatus* (Busk). 87.12.9.187. Challenger St. 147, off Crozet Islands. Ovicell from type-specimen. D. *C. asymmetricus* sp.n. 87.12.9.188<sup>1</sup>. Challenger St. 320, off Patagonian Shelf. Ovicell from paratype-specimen.

*d.z.* distal zoecium, *f.z.* fertile zoecium, *sp.* spine.

20. *Camptoplites areolatus* (Kluge). Figs. 54 A, B, 55 A, B.

*Bugula areolata* Kluge, 1914, p. 627, pl. xxviii, fig. 3, text-fig. 13.

*Camptoplites areolatus* Harmer, 1923, p. 300.

? *Bugula* sp. var. *variospinosa* Kluge, 1914, p. 628, pl. xxviii, fig. 4.

? *Bugula reticulata* Waters, 1904, p. 22; Calvet, 1909, p. 7, pl. i, fig. 3.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, St. 175.

GEOGRAPHICAL DISTRIBUTION. South Shetland Islands (Discovery); Palmer Archipelago? (Calvet); Bellingshausen Sea? (Waters); Wilhelm II Land (Kluge); Oates Land (Terra Nova).

These small specimens from the Antarctic agree very well with Kluge's account of *Camptoplites areolatus*. There is usually a flexible zone or incipient joint at the base of the branch, passing proximally to the opesia of the inner zooecium. The ovicells are radially striated at first, but in one or two, on Discovery fragments, a faint trace of superimposed reticulation can be seen (Fig. 54 B), and this calcification had evidently proceeded further in Kluge's material. If Kluge is right in attributing *C. reticulatus* (Calvet, 1909, pl. i, fig. 3, not Busk) to this species the reticulation must eventually become thick and heavy as in *C. retiformis*, a species which Calvet's figure might well represent (see p. 455).

*C. retiformis* and *C. areolatus* also resemble each other in their avicularia which are similar in general shape (cf. Figs. 47 A-G and 55 A, B). *C. areolatus* differs from *C. retiformis* in its biserial, jointed colony, in the presence of a second outer distal spine on many zooecia and in the possession of a cryptocyst.

The Antarctic form identified by Waters with *C. reticulatus* probably belonged to this species, as suggested by Kluge, but Busk's South Atlantic specimens appear to be distinct from both (see *C. asymmetricus*, below).

*C. areolatus* and *C. asymmetricus* clearly belong to *Camptoplites*, for they have the characteristic stalked avicularia, and axillary rootlets arising from chambers with runners. The zooecia are rather more calcified than those of other species of *Camptoplites* and their shape is reminiscent of the Scrupocellariidae, especially of some species of *Notoplites*. This resemblance is increased by the tendency to form joints (Fig. 54 C), and by the presence of a line of lateral oval areas (Fig. 54 B, D) which are, however, also to be seen in *C. bicornis* var. *quadriavicularis* (see p. 449).

Var. *variospinosa* (Kluge) was described from two small colonies and a fragment. One of the colonies had an ancestrula. They differed from the typical form in the greater number of spines, in the shape of the zooecia which were considerably wider distally, and in possessing only one kind of avicularium, but these are juvenile features, and it seems probable that var. *variospinosa* is no more than the young colony of typical *C. areolatus*. *Bugula reticulata* var. *spinosa* Waters (1904, p. 22), given by Kluge as a doubtful synonym of var. *variospinosa*, appears to be the young colony of some other species (see p. 441).

## 21. *Camptoplites asymmetricus* sp.n. Figs. 53 D, 54 C, D, 55 C-F.

*Bugula reticulata* Busk (part), 1884, p. 40 (not figured).

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, St. WS 840. *Antarctic*: Weddell Quadrant, St. 156.

GEOGRAPHICAL DISTRIBUTION. Off Patagonian Shelf below 400 m. (Busk; Discovery); Chile (Busk); South Georgia (Discovery).

HOLOTYPE. Challenger, St. 320, 1098 m., 87.12.9.188.

PARATYPES. Challenger, St. 320, 1098 m., 87.12.9.184, 99.7.1.283, 34.11.12.11, Challenger, St. 308<sup>1</sup>, 320 m., 87.12.9.186.

<sup>1</sup> This is wrongly given in the Challenger Report as St. 303 (see Murray, 1895, p. 1138).

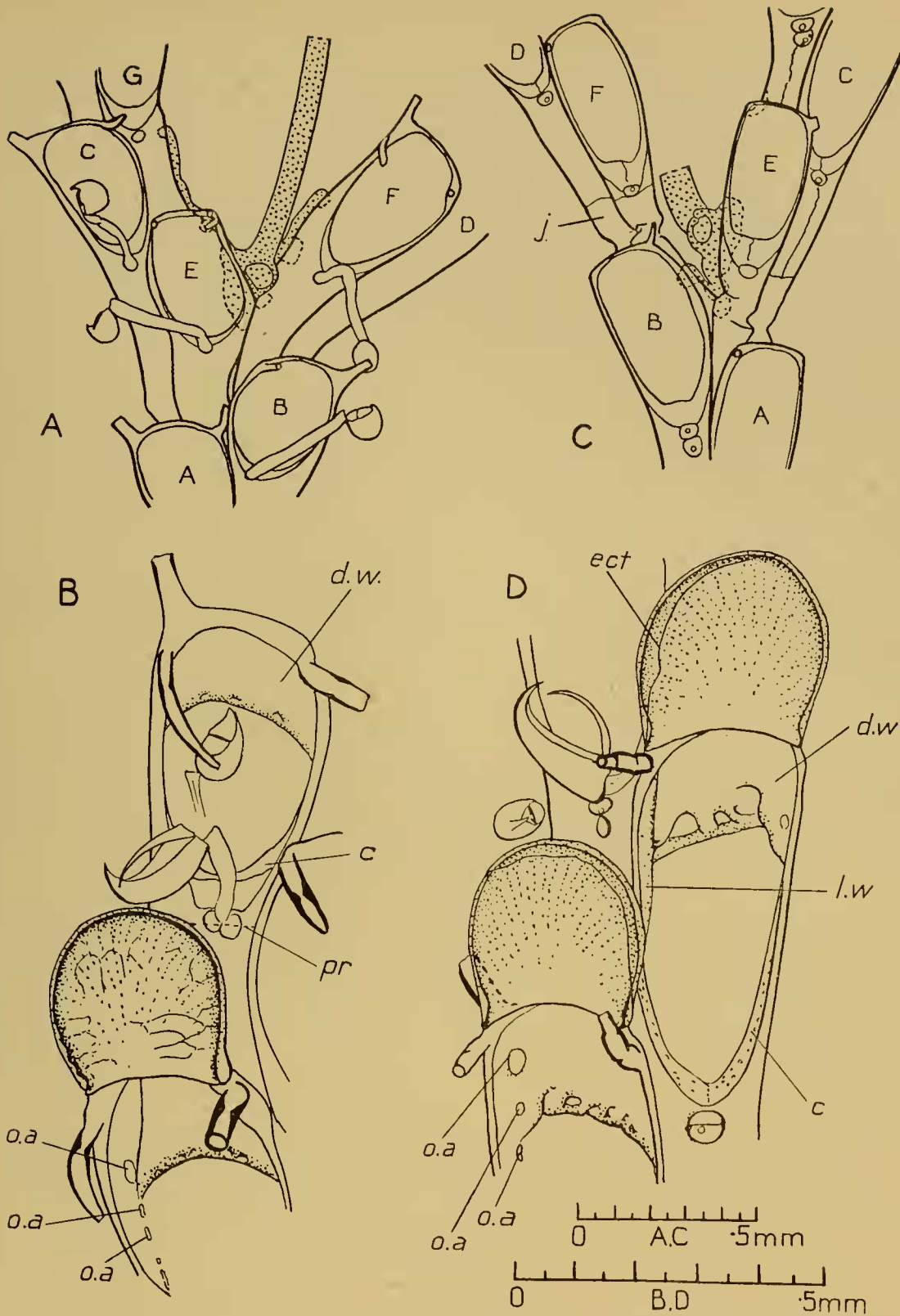


Fig. 54. A, B. *Camptoplites areolatus* (Kluge). St. 175, South Shetland Islands. A. Bifurcation in frontal view. This bifurcation is near the top of the branch. An older one would show more distinct flexible zones or incipient joints. B. Two zoecia and an ovicell. The stalk of the small avicularium is partly indistinguishable though its point of attachment beside the large avicularium is clearly visible. The thickened edge of the cryptocyst is outlined. C, D. *C. asymmetricus* sp.n. C. 87.12.9.188<sup>1</sup>. Challenger St. 320, off Patagonian Shelf. Bifurcation in frontal view. D. St. 156, South Georgia. The stalks of the avicularia are invisible. The second outer distal spine underlies the ovicell.

In Figs. A and C the zoecia are lettered according to Harmer's scheme and the axillary chamber, runners and rootlet are stippled. *c.* cryptocyst, *d.w.* distal wall, *ect.* edge of calcified part of ectoecium, *j.* joint, *l.w.* lateral wall, *o.a.* lateral oval areas, *pr.* position of projection from basal wall (indicated by dotted line).

DESCRIPTION. This species differs from *Camptoplites areolatus* (Kluge) in the absence of the calcareous projection from the basal wall ("kleine halbmondformige, kalkige querscheide" of Kluge), in the asymmetrical origin of the axillary rootlets, in the longer opesia, in the shape of the larger type of avicularium, and in the ovicells.

In *C. areolatus* zooecia E and F at the bifurcation are in contact for some distance (Fig. 54 A), the actual bifurcation occurring at about the level of the proximal end of the opesia of zooecium E (lettering as in Harmer, 1923). When an axillary rootlet is formed it arises from the usual type of symmetrical, more or less triangular, axillary chamber, with a pair of distal runners. In *C. asymmetricus* zooecia E and F are only joined by a small proximal connecting process, the bifurcation occurring beside the opesia of zooecium B (Fig. 54 C). The axillary chamber takes the form of a tube running from the axil along the side of zooecium E and giving rise to a rootlet at a point nearly half way along the side of the zooecium. A runner is sometimes formed and passes along

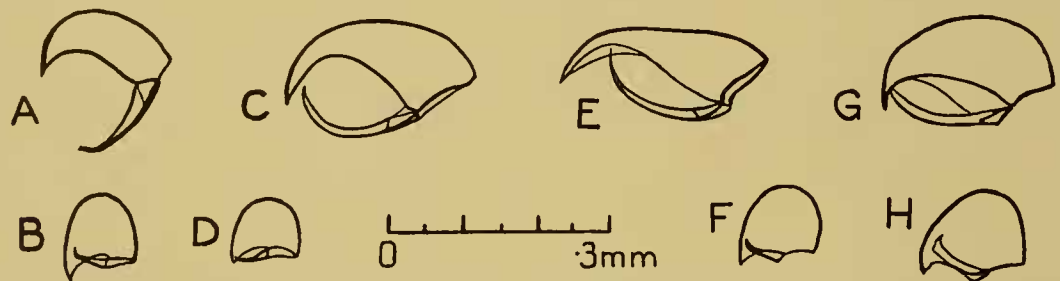


Fig. 55. A, B. *Camptoplites areolatus* (Kluge) St. 175, South Shetland Islands. C, D. *C. asymmetricus* sp.n. 87.12.9.188<sup>3</sup>. Challenger St. 320, off Patagonian Shelf. E, F. *C. asymmetricus* sp.n. St. 156, South Georgia. G, H. *C. reticulatus* (Busk). 87.12.9.187. Challenger St. 147, off Crozet Islands. Avicularia.

the side of zooecium F. The greater separation of zooecia E and F and the condition of the axillary chamber may perhaps be correlated with the more complete differentiation of the joints in *C. asymmetricus*, if this difference in the joints proves to be a constant feature when more material is examined.

The large avicularia are a little longer and less curved than those of *C. areolatus* (cf. Fig. 55 A, C and E), this flattening of the head being particularly marked in the specimen from South Georgia (Fig. 55 E).

The ovicells show a faint, fine, radial striation on the entoecium (Figs. 53 D, 54 D). In the material that I have examined there is no sign of this being superseded by any other sculpture, and the ectoecium remains incompletely calcified.

In both *C. asymmetricus* and *C. areolatus* the distal communication pores are more irregular in size, shape and number than Kluge supposed, and there is a tendency to thickening of the intervening portions of the wall (Fig. 54 B, D).

The Challenger specimens, which have been made the types of *C. asymmetricus*, were included in *Bugula reticulata* by Busk. They differ from the type-specimen of that species in the presence of joints, in the asymmetrical axillary rootlet-chambers and the absence of runners from the lateral chambers, in the presence of a cryptocyst, and, as far as the



evidence goes at present, in the smaller size and simple radial sculpture of the ovicells (cf. Fig. 53 C and D).

*Erymophora* gen.n.

GENOTYPE. *Brettia pellucida* var. *gracilis* Nichols, 1911, p. 7, pl. i, figs. 1-3.

DEFINITION. Zoarium erect, uniserial. Branches originating as lateral buds and projecting at right angles to branch, usually connected by a tube with zoecium proximal to parent zoecium. Zooecia tubular and jointed proximally, expanded distally. Opesia membraniporine, oval, with narrow cryptocyst. Avicularia (when present) stalked,

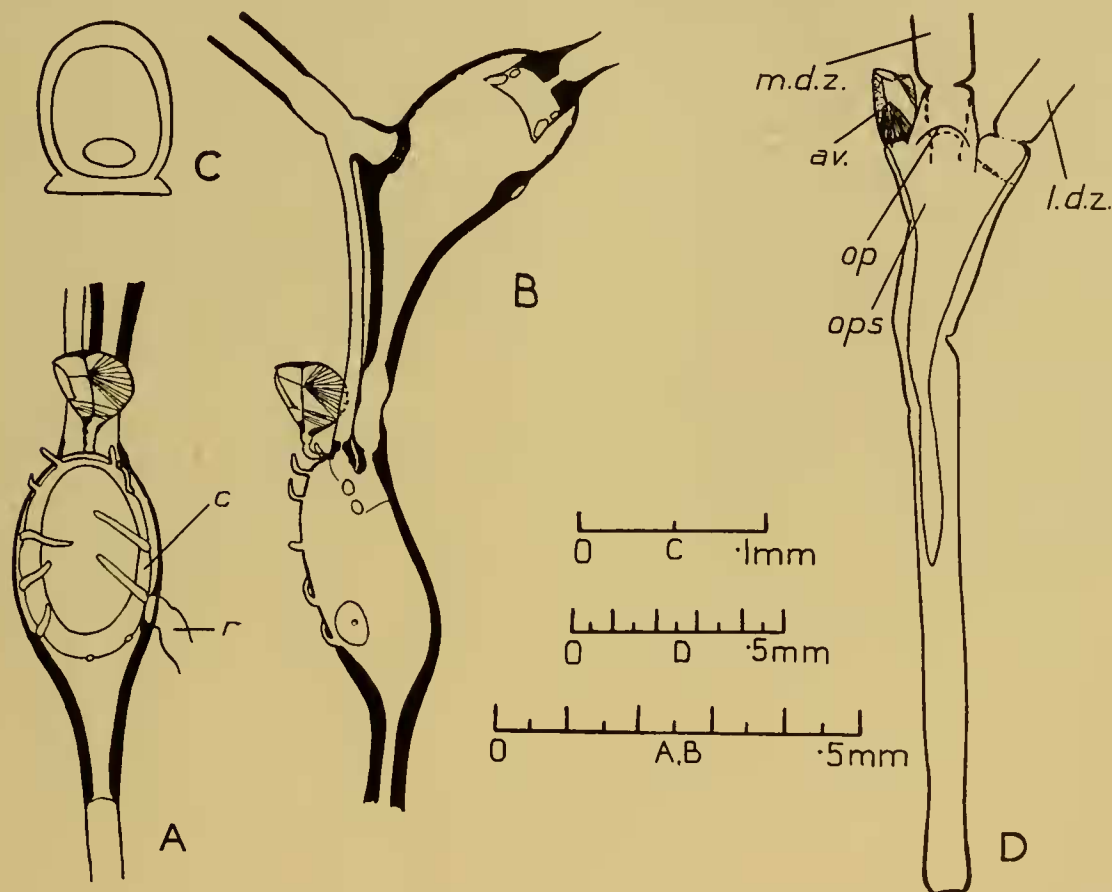


Fig. 56. A-C. *Erymophora* sp. indet. Specimen received from Professor Hickson from the Terra Nova collection. Locality unknown. A. Frontal view. B. Basal view, with the proximal zoecium twisted into an oblique view in mounting. C. Mandible. D. *Brettia triplex* sp.n. St. TN 194, off Oates Land. One rather crumpled zoecium.

av. avicularium, c. cryptocyst, l.d.z. lateral distal zoecium, m.d.z. median distal zoecium, op. operculum, ops. opesia, r. rootlet.

capitate, attached medianly to distal wall, mandible rounded. Ovicells (only known in genotype) hyperstomial.

REMARKS. This genus is included in the Bicellariellidae on the evidence of a small specimen bearing stalked avicularia found by Professor Hickson among Terra Nova material from an unknown locality (Fig. 56 A-C). The avicularia resemble those of

other Bicellariellidae except for their blunt mandible. The zooecia agree very exactly with those of the genotype. There are no ovicells. It is possible that this specimen actually belongs to *Erymophora gracilis*, but, in the absence of ovicells and of any information about the locality, this point must remain unsettled. The only samples of the Atlantic bottom fauna taken by the 'Terra Nova' came from 229 m. and 73 m. off Brazil (Sts. TN 38 and TN 42), whereas the type-specimen of *E. gracilis* was taken in 1295-1299 m. (707-710 fm.) off south-west Ireland.

*E. gracilis* was described as a species of *Brettia*, but the zooecia not only differ from those of *Brettia* in the presence of avicularia, but also in being well calcified and having a cryptocyst and helmet-shaped ovicell. It is thus unlikely to belong to *Corynoporella* Hincks (1888, p. 215), which is described as resembling typical *Brettia* except for the presence of avicularia. I have not seen a specimen of the genotype *Corynoporella tenuis*. *Erymophora gracilis* is further distinguished from *Corynoporella* by its branching. The lateral origin of the branches is not in itself a valid distinction, *Notoplites tenuis* var. *uniserialis*, for example, forms branches both by lateral buds and by paired distal buds (see p. 351), but the tubular connexion is a peculiar feature. The origin of the tube from the lateral zooecium might be compared to the origin of a rootlet, though there is unrestricted communication between the cavity of the zooecium and that of the tube. It is not, however, just a rootlet attached to another zooecium by its tip, for the connexion between its other end and the proximal zooecium is like that between two zooecia, so that it appears as if the parent zooecium had produced two distal buds. Such an arrangement is difficult to interpret, but as it is found in *Erymophora gracilis*, *E. klugei* and in the unnamed Terra Nova specimen, it appears to be a character of some importance.

*Allantopora* Lang (1914, p. 436), the membraniporine genus to which *Erymophora gracilis* has been compared (Harmer, 1926, p. 225, and footnote, p. 198), differs in its branching, is not known to have avicularia, and is encrusting.

### 1. *Erymophora gracilis* (Nichols).

*Brettia pellucida* var. *gracilis* Nichols, 1911, p. 7, pl. i, figs. 1-3.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. 51° 15' N, 11° 47' W, 707-710 fm., off south-west Ireland (Nichols).

Part of Nichols's type material, unfortunately without ovicells, is in the British Museum (11.10.1.851). I have nothing to add to Nichols's description. The Terra Nova specimen described above (Fig. 56 A-C) may belong to this species.

### 2. *Erymophora klugei* sp.n.

*Brettia* sp. Kluge, 1914, p. 642, text-fig. 24.

? *Brettia longa* (part) Waters, 1904, pl. i, fig. 2a.

STATION DISTRIBUTION. *Antarctic*: Weddell Quadrant, St. 1948.

GEOGRAPHICAL DISTRIBUTION. Near Elephant Island (Discovery); Bellingshausen Sea? (Waters); Wilhelm II Land (Kluge); Oates Land (Terra Nova).

HOLOTYPE. Kluge's figured specimen, which I have not seen, becomes the holotype.

This Antarctic species is only known from scanty fragments. It agrees with *Erymophora gracilis* in its zoarial characters, having zooecia of similar shape and the same curious longitudinal connexion between the lateral branch and the proximal zooecium. It has a wider cryptocyst and, instead of the series of marginal spines, it has at most four short distal spines. Ovicells and avicularia are unknown. The Discovery material consists of a few dead zooecia, found imbedded in a sponge, and does not show any of the curious tubular connexions.

Kluge showed that Waters confused two species in *Brettia longa*, one of which may be the species here called *Erymophora klugei*. He restricted Waters's name to the other species, discussed above under *Notoplites tenuis* var. *uniserialis* (p. 352).

### Aetea Lamouroux, 1812

#### 1. *Aetea anguina* (Linnaeus). Fig. 57 A-C.

*Sertularia anguina* Linnaeus, 1758, p. 816.

*Aetea anguina* Busk, 1884, p. 2; Marcus, 1921*a*, text-fig. 15; Harmer, 1926, p. 194, pl. xiii, figs. 3, 4 (synonymy); Hastings, 1932, p. 408; Hasenbank, 1932, p. 324; Osburn, 1933, p. 306, pl. xv, fig. 12; Marcus, 1937, p. 26, pl. v, fig. 8; Livingstone, 1937, p. 377; Marcus, 1938*b*, p. 199; Neviani, 1939, p. 14.

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 4, 399, 1187, 1902, WS 84, WS 847. *Victoria*: St. 1686.

GEOGRAPHICAL DISTRIBUTION. Throughout tropical and temperate regions including: Chile (Busk); Brazil; Juan Fernandez (Marcus); Tristan da Cunha (Busk; Discovery); Gough Island; Patagonian Shelf (Discovery); South Africa (Hasenbank).

Busk (1852*b*, p. 31) recorded this species from the "Antarctic Ocean", but there is no trace of any specimen on which he might have based his statement, nor any authority for it in the earlier writings that he lists. The 'Discovery' did not find the genus farther south than the Falkland Islands. Waters (1904, p. 20) recorded three or four zooecia of an unnamed *Aetea*, resembling *A. recta*, from "Tangles VIII"<sup>1</sup> in 70° S, but the other Antarctic expeditions whose reports have been published did not find the genus at any Antarctic station. I therefore regard the existence of *Aetea* in the Antarctic as still somewhat dubious. Marcus (1938*b*) came to a similar conclusion.

The material from St. 1902 (Patagonian coast) comprises small colonies on a hydroid and on seaweed. Those on the weed have a shorter, broader opesia with its proximal edge tending to turn outwards, but both forms fall within the range of *A. anguina* as generally understood. The erect part of the zooecia of both is curved.

In some of the specimens from Tristan, notably those from St. 1187, 18 November 1933, a membranous sac is frequently to be seen placed symmetrically on the frontal membrane, proximally to the operculum, and containing an embryo (Fig. 57 A). No opening to the sac could be detected. The frontal membrane is strongly depressed in these preserved specimens, and, where the embryo is small, the whole sac lies in the hollow so formed without projecting beyond the borders of the opesia as seen in profile. At this stage the sac is so closely applied to the membrane that its basal wall

<sup>1</sup> He gives the number 986 which does not appear in his lists on pp. 3 and 15.

cannot be discerned as distinct from the membrane. With larger embryos the sac projects as shown in Fig. 57 A, but is still in close contact with the frontal membrane. Two sacs with large and apparently advanced embryos are free from the membrane except for a distal attachment proximal to the operculum (Fig. 57 B), and an empty shrivelled sac has a similar attachment (Fig. 57 C). In this last specimen the frontal membrane is mainly convex, but shows a well-marked depression where the sac may be presumed to have rested at an earlier stage. This depression is, however, not to be seen in the specimen shown in Fig. 57 B.

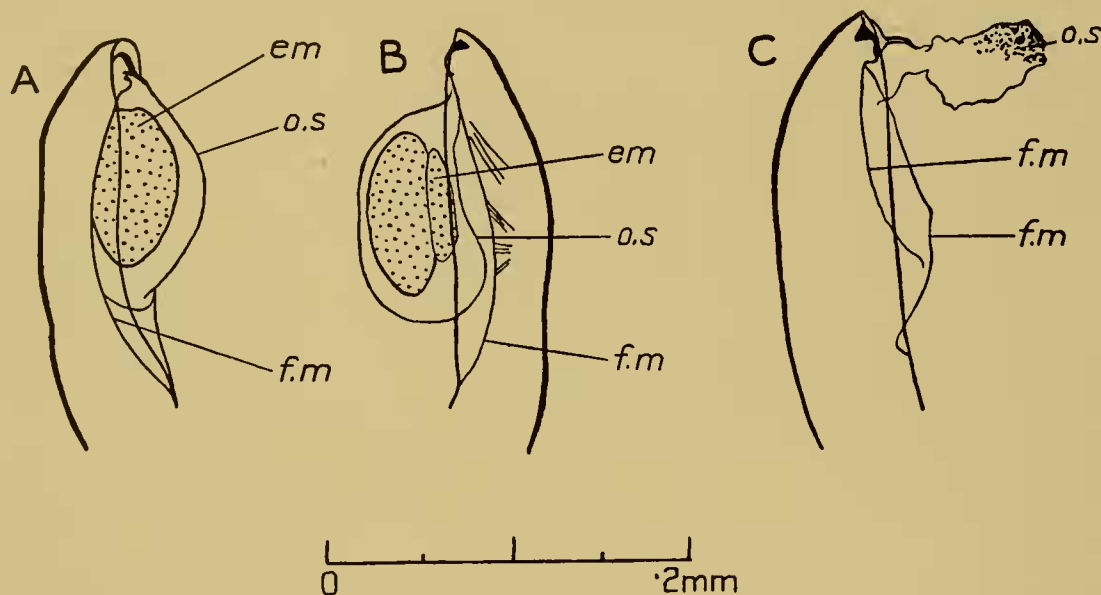


Fig. 57. A-C. *Aetea anguina* (Linnaeus). St. 1187, Tristan da Cunha. Distal ends of zoecia showing supposed ovisacs. Sculpture omitted. A. Ovisac closely appressed to frontal membrane. B. Ovisac free from frontal membrane, embryo more advanced than in A. C. Ovisac empty and shrivelled.

*em.* embryo (stippled), *f.m.* frontal membrane, *o.s.* ovisac.

I have seen the sacs in fifty-nine zoecia, and their constantly symmetrical position and absence from other parts of the zoecium give a very strong impression that they are part of the Polyzoan, and not the attached egg-capsule of another animal. On the other hand it is difficult to reconcile these observations with those of Waters (1913, p. 463), Osburn (1912, p. 220) and Marcus (1937, p. 27) of distal embryo-sacs in this species. The older, partly detached, sacs somewhat resemble those of Osburn and Marcus, but the attachment in my material is certainly proximal to the orifice. In Waters's figure the ovisac is shown as a spherical vesicle attached to the calcareous wall and unconnected with the aperture. In view of the resemblance between the ovisacs of *Aetea* and those of such Ctenostomes as *Nolella* (see Harmer, 1926, p. 193) it might be suggested that their position is indeterminate were it not found to be so constant in any one batch of material.

The frontal ovisacs appear to be the "membranous bags" described by Robertson (1905, p. 245) as "ooecia". The apparently asymmetrical position of the sac in her

figure is, I think, due to the omission of the nearer calcareous wall of the head of the zooecium, which would have been visible at a higher focus. In my material the cells are more closely packed, but an embryo with loosely packed, rounded cells, as in that figure, might be found at a different stage of segmentation.

Marcus (1937, p. 28) made the suggestion, warranted by the figure, that the structures seen by Robertson were algae such as he had found attached to his own material in various positions. The contents of the sacs in my specimens are certainly animal embryos, though I do not know whether they are Polyzoan. It is, however, worth noticing that the most advanced embryo resembles many Polyzoan larvae in shape (Fig. 57 B). Despite his suggestion that Robertson's ovisacs were algae Marcus later (1938*b*) regarded the form with frontal ovisacs as a distinct species, but the very close agreement in other characters seems to preclude this separation.

Examination of zooecia stained with borax carmine (without decalcification) and mounted in canada balsam has shown me beyond doubt that the spots on the walls are pores, as described by Levinsen, not protuberances. The examination of the optical section of the wall as seen at the periphery of a profile view proves this, for the fine tubes or passages can be seen, corresponding to the dots and passing through the thickness of the wall at right angles to the surface. Moreover, examination of the annulated part in optical section shows which of the alternating rings are calcareous and which not, the calcareous ones being thicker in section. The calcareous rings have a slightly more opaque, greyer appearance than the non-calcareous ones, and they exactly match the wall between the dots in colour and texture. The fusion of dots to form linear marks and then rings, as described by Marcus, is to be seen, but the rings so formed are the non-calcareous ones, as might be expected from the fusion of pores.

2. *Aetea curta* Jullien. Plate XIII, fig. 1; Fig. 58 A, B.

*Aetea curta* Jullien, 1888, p. 26.

? *Aetea truncata* Marcus, 1938*a*, p. 11, pl. i, fig. 4.

STATION DISTRIBUTION. *Ascension Island*: St. 1.

GEOGRAPHICAL DISTRIBUTION. Magellanic Region (Jullien); Brazil? (Marcus); *Ascension Island* (Discovery).

A specimen of *Aetea* from *Ascension Island* has zooecia in which the erect part is shorter than the encrusting part, and the opesia nearly always occupies more than half the length of the erect part (Fig. 58 A, B). The encrusting part tapers at the proximal end, but for at least half its length it is dilated and wider than the erect part. The erect part is relatively of very uniform width, and may be somewhat curved. The surface of the zooecia is very finely punctate almost throughout, only the extreme proximal end of the encrusting part appearing smooth. In this species, as in *A. anguina*, the punctations are pores. This is particularly clearly seen at the broken edge of a piece of the wall mounted in balsam, and can also be deduced from the appearance of the optical section of the wall seen at the periphery of mounted specimens. The pores are much smaller than those of *A. anguina*. In addition to the pores the encrusting part and the tubular

erect part, below the opesia, may be annulated. These annulations are undulations of the whole punctate wall, and must not be confused with the rings sculptured on the surface of the wall in *A. anguina* and *A. recta*. Zoeciules and appendages are present, as in *A. truncata* (see Harmer, 1926, p. 197), and the zooecia have the truncate distal end and oblique operculum of that species.

British specimens of *A. truncata*, including two preparations from Landsborough's material from Arran (99.7.1.566, 567, presumably part of the type-material), differ from these Ascension Island specimens in various ways (cf. Plate XIII, figs. 1 and 2). The zooecia are smaller and more slender. The erect part is very straight and markedly tapering proximally, as shown in Hincks's figures (1880, pl. i, figs. 8-11; pl. ii, fig. 3).

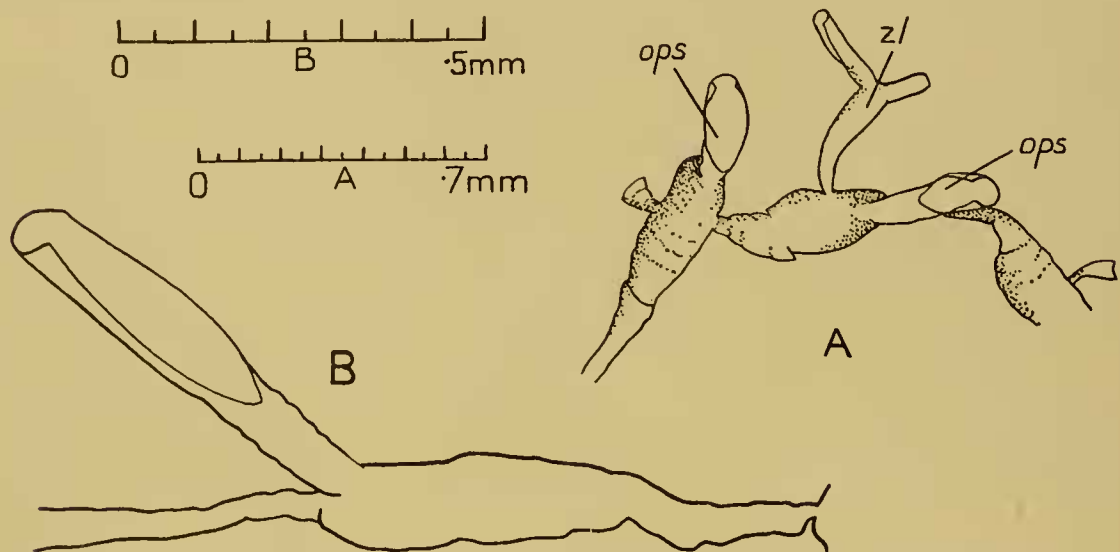


Fig. 58. *Aetea curta* Jullien. St. 1, Ascension Island. A. Dry specimen, seen by reflected light. Erect parts much foreshortened. B. One zooecium and parts of adjacent ones in an oblique frontal view.

*ops.* opesia, *zl.* zoeciule.

The opesia usually occupies less than half the length of the erect part. The encrusting part is narrower than the erect part, threadlike for the greater part of its length, and usually even longer in proportion to the erect part than is that of the Ascension Island specimens. There is no trace of annulation. I have seen neither zoeciules nor appendages in British specimens, but they might be found if more material were examined. The relative lengths of the various parts vary to some extent probably with conditions of growth, but the differences in shape and absolute size make the Ascension Island form clearly distinguishable from typical British *A. truncata*.

On this argument many of the specimens from various parts of the world, recorded as *A. truncata*, would be distinct from the British species, and I think this is probably so. Marcus's figure of his *A. truncata* shows most of the features of the Ascension Island species.

It remains to consider whether the Ascension Island form can be identified with any described species. Jullien described *A. curta* as having the "pédoncule" (i.e. the tubular

portion of the erect part) punctate and "annelé", and the rest of the zooecium punctate. It is clear from his account of the striations of his next species (*A. australis*) that they were of the same type as those of *A. recta*, and that in *A. curta* he was describing something more coarse. The Ascension Island form thus agrees with *A. curta* in being punctate all over and partially annulated, and in the shortness of its erect part, but the annulations extend to the encrusting part, which is wider than the erect part. In *A. curta* these parts were of the same width. The opesia is a little longer in proportion to the rest of the erect part, but this relation is variable, and, as we have already seen, may alter with growth. On the whole I am inclined to identify the Ascension Island specimens with *A. curta*.

*A. curta* may, however, be a synonym of *A. ligulata* Busk. That species also has punctate zooecia with coarse annulation on the tubular erect part, and zooeciules and appendages are present (Marcus, 1937, pl. iv, fig. 10). A constriction below the opesia is to be seen in some dried zooecia from the Ascension Island colony of *A. curta*, but it is clearly the result of drying. To judge from Marcus's figure the constriction in *A. ligulata* is not due to drying, for it is well marked in a zooecium with extended tentacles. The opesia is much shorter, and the tubular erect part longer in proportion to the other parts of the zooecium than in the Ascension Island specimens, but this, as we have said, may depend on age. Marcus suggested that the absence of punctation on the thread-like proximal part in *A. curta* might be a distinction, but this character is difficult to establish with certainty and, where the punctations appear to be absent, only a very small area at the extreme proximal end is affected, so that I doubt whether it is a distinction of any importance. Thus it may well be found that *A. ligulata* includes *A. curta* in its range of variation. As they were both originally described from the southern extremity of South America, this conclusion is the more probable. On the other hand, Marcus gives good evidence for the existence of two species in Brazilian waters, namely, *A. ligulata* and his *A. truncata* (which differs from the British form and may be *A. curta*).

On the strength of my examination of the type material of *A. crosslandi* Waters (1910, p. 253) lent by the Manchester Museum, Marcus (1937, p. 30) has included that species in the synonymy of *A. ligulata*. Fragments from Mauritius (86.2.5.53) appear to belong to this species. I should also include the specimens from the Panama region recorded by me as *A. truncata* (Hastings, 1930, p. 702), and it is possible that some other records of *A. truncata* in the tropics may be based on *A. ligulata*.

*A. fuegensis* Jullien (1888, p. 25) described from a single mounted specimen, appears to have had the same combination of fine spots and coarse annulation, but it had a peculiar prolongation of the zooecium beyond the orifice. It has not been redescribed. Vallentin (1924, p. 373) believed that he had recognized it, but there is no specimen of *Aetea* in his Falkland Island collection, which is now in the British Museum.

#### Scruparia Oken, 1815

##### 1. *Scruparia ambigua* (d'Orbigny).

*Eucratea ambigua* d'Orbigny, 1841, pl. iii, figs. 13-17, 1847, p. 11.

*Scruparia ambigua* Hastings, 1941, p. 470, text-fig. 2 A, B (synonymy).

STATION DISTRIBUTION. *Sub-Antarctic*: South Atlantic Ocean, Sts. 222, 1902, WS 95, WS 847. *Victoria*: St. 1686.

GEOGRAPHICAL DISTRIBUTION. South-west and west of Great Britain; Ireland; France; Norway; ? Sweden; Adriatic; Patagonian Shelf; Magellanic Region; Amsterdam Island, Indian Ocean; Australia; Tasmania; New Zealand; California; Galapagos Islands.

The sources of the recorded distribution are given by Hastings. Eight ancestrulae were taken at St. WS 847, near the Patagonian coast, on 2 September 1932.

### Brettia Dyster, 1858

#### 1. *Brettia inornata* (Goldstein).

*Alysidium inornata* (sic) Goldstein, 1882, p. 42, pl. i, fig. 1.

*Catenaria attenuata* Busk, 1884, p. 14, pl. ii, figs. 1, 1a.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Marion Island (Goldstein); Heard Island (Busk).

Busk's figure gives a false impression of a semicircular orifice. Actually his specimens show a short, oval, membranous opesia, as in Goldstein's figure, and I have no doubt of the synonymy of the two forms. The shading of the opesia in Goldstein's figure, leaving a central clear oval, is curious, but one zooecium in Busk's dry mounts had a similar appearance. On mounting this zooecium as a transparency it was seen that the appearance is due to an accumulation of detritus round the edges of the frontal membrane.

In general appearance this species suggests *Brettia*, and, as it shows all the features of the genotype as enumerated by Harmer (1926, p. 198), I propose to place it in that genus for the present (see p. 477).

The zooecia are uniserial and may give rise to a single median distal zooecium or to two asymmetrically placed zooecia one of which is nearly but not quite median and the other more lateral. In both these arrangements the parent zooecium is very little wider distally and has no "shoulders". In a third arrangement the zooecium has a suggestion of shoulders, like those of *B. triplex*, but each shoulder carries a symmetrically placed lateral distal zooecium and there is nothing in the median distal position.

There is an ancestrula on Busk's slide 99.7.1.3653. It is rather short but does not otherwise differ from the other zooecia in shape. It is separated by a constriction from the small disk by which it is attached to a foraminiferan.

#### 2. *Brettia triplex* sp.n. Fig. 56 D.

STATION DISTRIBUTION. Not represented in the Discovery collections.

GEOGRAPHICAL DISTRIBUTION. Oates Land (Terra Nova, St. TN 194).

HOLOTYPE. St. TN 194.

DESCRIPTION. *Zoarium* uniserial, bifurcating, each zooecium giving rise to two asymmetrically placed distal zooecia, one median or very nearly so, the other lateral to it.

*Zooecia* elongate 1-3 mm. long, expanded distally, one shoulder giving rise to the lateral distal zooecium, the other carrying an avicularium (Fig. 56 D). A small proximal segment separated by a deep constriction.



*Opesia* triangular, acutely pointed proximally, a little less than half the length of the zooecium. Orifice distal.

*Avicularium* rigidly attached, erect, with beak directed away from axis of branch.

*Ovicells* unknown.

REMARKS. About forty zooecia of this species were found in a jar of mixed fragments of several species all in a very brittle state. In most instances one or other of the two distal zooecia has been broken off, but they have left signs of breakage which leave me with no doubt that the triple arrangement, in which each zooecium supports a median distal zooecium, a distal lateral zooecium and a distal lateral avicularium, is typical. This species differs from *Brettia inornata* in the presence of avicularia, in the longer opesia, in the more pronounced shoulders supporting the lateral distal zooecium and avicularium and in the formation of median distal buds. There can be little doubt that the two forms are congeneric, and I have put them provisionally into *Brettia*, although the avicularia of *B. triplex* may ultimately exclude them from that genus. More material of *B. triplex* is very desirable.

These two species show some resemblance to *Maplestonia simplex* MacGillivray (1885, p. 107, pl. i, figs. 2, 2a, 2b = *Brettia simplex* Levinsen, 1909, p. 113, pl. iv, fig. 9 a, b), but not to the genotype of *Maplestonia*, *M. cirrata* MacGillivray.

## GEOGRAPHICAL DISTRIBUTION

This report deals with so small a proportion of the Antarctic Polyzoa that their distribution cannot profitably be compared with that of other groups. The facts of the distribution of the species and genera considered in the report may, however, be usefully summarized.

### DISTRIBUTION OF THE SPECIES

The distribution of the Antarctic and sub-Antarctic species of the families dealt with is given in Table 3. The Antarctic and sub-Antarctic areas are taken as the region south of the subtropical convergence (see map, Fig. 59). The subtropical convergence curves northwards in the south-eastern Pacific and goes off this map. Gunther (1936, p. 236) found it along the 30–32° S parallels in 95–105° W; and in 70–71° W, nearer the Chilean coast, it was as far north as 24–26° S. Thus Juan Fernandez and Valparaiso come within the sub-Antarctic area hydrologically. This is in keeping with the relationship between the faunas of Juan Fernandez and the Magellanic region discussed by Marcus (1921a, pp. 93–5).

In Table 3 the non-abyssal localities are grouped regionally as follows: (1) Australasian, (2) South Pacific, (3) South Atlantic Ocean, (4) South Indian Ocean, (5) Weddell Quadrant (plus Bouvet Island), (6) Victoria Quadrant. The localities are arranged from north to south except in the Victoria Quadrant where they are arranged from east to west. The abyssal stations, both Antarctic and sub-Antarctic, are all treated together in the last column. The South Pacific column includes Challenger St. 308 which is in 320 m. and is comparable with the stations off the Patagonian shelf (see p. 486). The order of the species is designed to group together those with similar distribution.

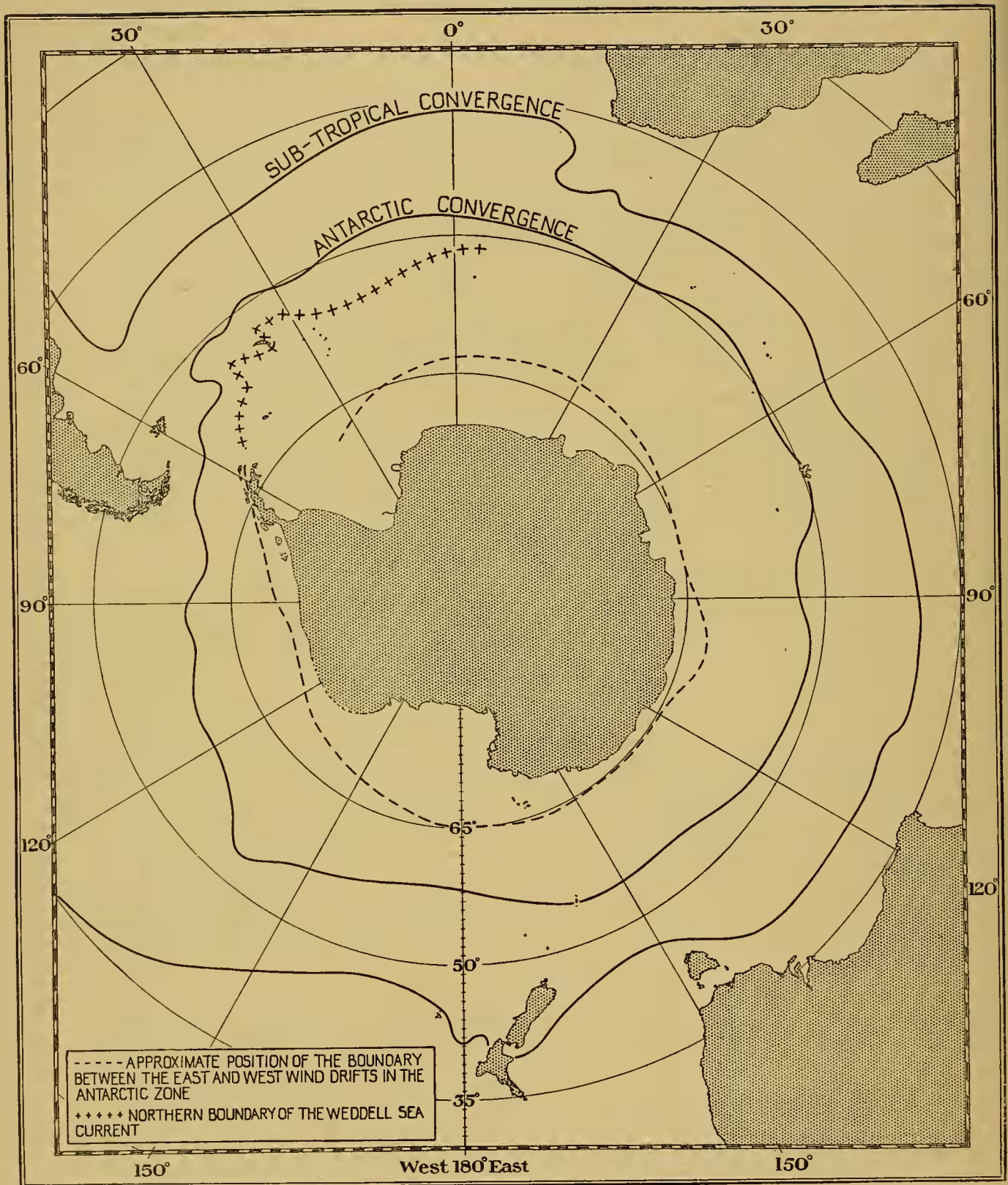


Fig. 59. Map of the south polar regions to show the Antarctic and subtropical convergences.







The thick line A represents the subtropical convergence. The entries to the left of this line indicate which species extend beyond the areas under consideration, and it is noticeable that the species with this wider distribution are a small minority. The details of their distribution, which in some is extensive, are to be found in the systematic part of this report.

The thick line B between the Falkland Islands and Heard Island marks the Antarctic convergence, all localities between lines A and B being between the two convergences and hydrologically sub-Antarctic, those to the right of line B south of the Antarctic convergence and hydrologically Antarctic.

The definition of the Antarctic and sub-Antarctic areas by means of the Antarctic and subtropical convergences gives them rather different limits from those accepted before the detailed work of the 'Discovery' (Deacon, 1933, 1937) was available. Hasenbank (1932, p. 323), for instance, regarded both Bouvet Island and Amsterdam Island (Neu Amsterdam) as sub-Antarctic, but Bouvet Island is south of the sub-Antarctic convergence and Amsterdam Island north of the subtropical convergence. The Antarctic affinities of the Bouvet Island Polyzoa appear from Hasenbank's own remarks. From Amsterdam Island he had *Scruparia ambigua* (recorded as *S. chelata*) which is known from the sub-Antarctic but is widely distributed in more northerly waters; and *Bugula dentata*, a widely distributed tropical and subtropical species (see p. 429).

The division between the Antarctic and sub-Antarctic regions is the most conspicuous feature of Table 3, the great majority of the species being found in one region or the other, but not in both. Only two of the few species common to the Antarctic and sub-Antarctic are widely distributed in both areas. The variation of *Caberea darwinii* in correlation with its distribution is described on p. 382. In *Cornucopina pectogemma*, which is less widely distributed in the sub-Antarctic regions, variation is less marked, and does not seem to be correlated with distribution. Among the remainder there are three Antarctic species that are only found, when north of the convergence, in the deeper water off the Patagonian Shelf (see p. 486), and four species known from South Indian islands on both sides of the convergence (see p. 483), one of which (*Bugula longissima*) reaches Ross Sea.

The fact that varieties are treated independently in the table does not seriously exaggerate the separation of the Antarctic and sub-Antarctic forms, for in only one instance (*Cornucopina ovalis*) are the typical form and the variety restricted to opposite sides of the convergence.

As the Antarctic convergence is a phenomenon of the surface waters, it is, at first sight, surprising that the distribution of bottom-living forms such as Polyzoa, should be so closely correlated with it. It must, however, be remembered that the Antarctic surface layer (Deacon, 1933, p. 173) is of considerable depth, and that the great majority of the Polyzoa have been taken in relatively shallow water, and would be subject to "surface" conditions. It has, moreover, been shown by Deacon (1937, pp. 3, 24) that the position of the convergence at the surface is determined by conditions in the deeper waters. His diagrams (1937, fig. 1, p. 4; fig. 5, p. 22) of the vertical circulation of the

water in the South Atlantic Ocean and of the temperatures at 2000–2500 m. throughout the area show that the Antarctic convergence corresponds to a marked change in conditions at all depths (cf. discussion of abyssal species, p. 484).

The Antarctic and sub-Antarctic abyssal records (right-hand column) are all from depths of more than 2000 m. A few of the records of these species outside the area (left-hand column) are from depths between 1000 m. and 2000 m. (see Table 3 A), and are thus not truly abyssal. They appear, however, to be part of a deep-water fauna best represented by the abyssal symbol.<sup>1</sup> Only four of the abyssal species extend into depths of less than 1000 m. and two of these are only known from deep water. The four species are *Farciminellum hexagonum*, known from Marion Island in the sub-Antarctic region and abyssally farther north; *Himantozoum sinuosum*, known from the islands of the south Indian Ocean and abyssally in the Antarctic; *Kinetoskias pocillum*, known abyssally off Valparaiso and in less than 733 m. off Brazil; and *Cornucopina conica*, known abyssally off the Crozet Islands and from the Malay Archipelago both abyssally and in 924 m. (see Table 3 A).

Within the sub-Antarctic area the few species known from the South Pacific region are, with the possible exception of the unnamed *Caberea* (see p. 390), also known from the South Atlantic region. The South Atlantic and South Indian regions have some species in common, but most are restricted to one or other of the two regions. Here, too, the tabulation of varieties and species independently makes little difference, *Notoplites elongatus* being the only instance where the species is in one zone and the variety in the other.

The islands of the South Indian Ocean are on the border-line hydrologically (see Deacon, 1933, p. 193). Marion Island, Prince Edward Island and the Crozet group are to the north of the Antarctic convergence, which passes through Kerguelen and leaves Heard Island well to the south. Hydrographic conditions in the region are complicated (see Deacon, 1937, pp. 31, 34, 35), but Heard Island is clearly Antarctic hydrologically.<sup>2</sup> Nevertheless, the Polyzoan fauna of Heard Island appears to be related to that of the other islands of the group. The Cellularine Polyzoa of the whole group of islands comprise (1) species not known elsewhere (except *Farciminellum hexagonum* found abyssally further north), (2) species also found in South Atlantic sub-Antarctic localities, (3) species common to the Antarctic and the South Atlantic or South Pacific regions of the sub-Antarctic, (4) species found in the Antarctic but not in the South Atlantic or South Pacific regions of the sub-Antarctic. Half the species are not known elsewhere (group 1). Of the remainder the majority are sub-Antarctic species unknown in the Antarctic (group 2), while group 4 only comprises two species, *Himantozoum sinuosum*, known abyssally in the Antarctic, and *Bugula longissima*. Moreover, the most characteristically Antarctic genus in this report, namely *Camptoplites* (see p. 492), has not

<sup>1</sup> A few of the non-abyssal species extend into depths of a little more than 1000 m., but such records have not been discriminated.

<sup>2</sup> The data published by Howard (1940, p. 43) afford further evidence of the Antarctic character of Heard Island. Forthcoming Discovery Station Lists will give hydrological data for more stations in this region.

been recorded from these islands except at an abyssal station. There are thus some grounds for regarding the Cellularine Polyzoa of the islands of the South Indian Ocean as sub-Antarctic rather than Antarctic.

It has seemed best to count Tristan da Cunha as sub-Antarctic, for the purposes of Table 3, although Deacon (1937, p. 59) shows that the subtropical convergence sometimes runs to the north and sometimes to the south of the island, which is thus not fully sub-Antarctic. Of the five species from Tristan in this report, two, *Caberea darwini* and *Cornucopina pectogemma*, are real Antarctic-sub-Antarctic species; two, *Scrupocellaria ornithorhyncus* and *Aetea anguina*, are found at various sub-Antarctic localities, but also extend more or less widely north of the area; and one, *Caberea rostrata*, is known from New Zealand.

In the Antarctic area the Weddell and Victoria Quadrants are on opposite sides of the Antarctic continent, and nearly half the species have only been found at one side or the other.

Table 3 A shows the distribution of the abyssal species known from the Antarctic and sub-Antarctic areas (○ in Table 3). The heavy lines A and B again represent the subtropical and Antarctic convergences respectively. Species from both sides of the Antarctic convergence have been recorded at localities north of the subtropical convergence, but there are only two species, *Himantozoum sinuosum* and *Cornucopina infundibulata*, that are known from both the Antarctic and the sub-Antarctic areas.

The three zones separated by the convergences have been subdivided geographically so that the table comprises eight sections. Considering the nine species that have been recorded from more than one of these sections, one notices, in the first place, that the more northerly records of the sub-Antarctic South Indian Ocean species are from the geographically adjacent Malay Archipelago, but that the species south of the Antarctic convergence have been found in the Atlantic Ocean or the northern part of the Indian Ocean, both of which are separated from the Antarctic localities by areas in which the species have not been found.

Deacon (1937, fig. 1) gives a diagram of the meridional circulation in the Atlantic Ocean, and has found a very similar circulation throughout the Southern Ocean (1937, pp. 3 etc. and figs. 5, 8).

Comparing Table 3 A with Deacon's diagram it appears that two of the Atlantic stations at which the Antarctic species were found, being below 4000 m. in the region north of the subtropical convergence, may well have been under the influence of the Antarctic bottom current and therefore comparable hydrologically to the Antarctic abyssal stations. (The third station was in only 3477 m.) Similarly the South Indian Ocean station with Malayan species was at 2938 m. in the region between the two convergences and was probably in the warm deep layer (see Deacon, 1937, pp. 3, 81). The Pacific station off Valparaiso is just south of the subtropical convergence in 3953 m., and may also have been in the warm deep layer. Its species are known from Malayan and South Indian localities, like the last group, and also from a relatively shallow station off Brazil, for which I have no hydrological data. The only marked discrepancy is the two Antarctic forms found off East Africa.



Table 3A. Distribution of the Cellularine Polyzoa known from abyssal stations within the Antarctic and sub-Antarctic areas

	A				B			
	Off Brazil	South Atlantic Ocean	Off East Africa	Malay Archipelago	Off Valparaiso	South Indian Ocean	Victoria quadrant	Weddell quadrant
	Challenger, St. 122, 58.6-732 m.	Challenger, St. 323, 3477 m. St. 325, 4850 m. St. 332, 4026 m.	Valdivia, St. 250, 1668 m.	Siboga, St. 170, 924 m. St. 211, 1158 m. St. 295, 2050 m. Challenger, St. 196, 1509 m.	Challenger, St. 299, 3953 m.	Challenger, Prince Edward Island, 146-275 m. Kerguelen, depth? St. 146, 2516 m. St. 147, 2938 m.	Challenger, St. 157, 3568 m. St. 156, 3614 m. St. 153, 3065 m. Gauss, 2450-3423 m.	Belgica, 2800 m.
Bottom temperature (Centigrade)	?	+ 0.6° + 0.4° + 1.1°	+ 3.8°	? ? ? + 2.7°	+ 1.8°	? ? + 2.0° + 1.2°	+ 0.6° - 0.4° + 0.1° ?	+ 0.5°
<i>Tricellaria</i> sp.	.	.	.	.	○	.	.	.
<i>Amastigia pateriformis</i>	.	.	.	.	○	.	.	.
<i>Kenella biseriata</i>	.	.	.	.	○	.	.	.
<i>Kinetoskias pocillum</i>	+	.	.	.	○	.	.	.
<i>Camptoplites reticulatus</i>	.	.	.	.	○	.	.	.
<i>Cornucopina conica</i>	.	.	.	+	○	.	.	.
<i>Camptoplites lunatus</i>	.	.	.	○	.	.	.	.
<i>Cornucopina infundibulata</i>	.	.	.	.	.	○	.	.
<i>Himantozoum sinuosum</i> <sup>1</sup>	.	.	○	.	.	+	.	.
<i>Camptoplites bicornis</i>	.	.	.	.	.	.	.	.
<i>Levinsenella magna</i>	.	○	○	.	.	.	○	.
<i>Himantozoum sinuosum</i> var. <i>variabilis</i>	.	.	.	.	.	.	○	.
<i>Notoplites perditus</i>	.	.	.	.	.	.	○	.
<i>Farciminellum lineare</i>	.	.	.	.	.	.	○	.
<i>Camptoplites abyssicolus</i>	.	.	.	.	.	.	○	.
<i>Cornucopina rotundata</i>	.	.	○	.	.	.	○	.
<i>Cornucopina angulata</i>	.	.	.	.	.	.	○	.
<i>Amastigia abyssicola</i>	.	.	.	.	.	.	○	○

<sup>1</sup> The entries under *Himantozoum sinuosum* comprise two forms and it is uncertain whether they should be treated as distinct (see p. 425). One was obtained from Valdivia St. 250, the other from the shallow south Indian Ocean Stations, and both appear to have been obtained abyssally in the Southern Ocean by the 'Gauss'.

Records in depths of less than 1000 m. are represented by a cross (+), records in more than 1000 m. by a circle (○).

As an indication of the actual hydrological conditions I have noted the bottom temperatures where known.<sup>1</sup> Much information on the general circulation is to be found in Deacon's report (1937). In particular his section 9 (pls. xvi-xviii), which runs from the Antarctic to Australia across the South Indian Ocean, is instructive in this connexion. His sections afford ample evidence that in the relatively shallow parts of the oceans the bottom fauna may be immersed in a water-layer which in deeper parts is an intermediate layer.

It thus seems possible, though the evidence is insufficient and not conclusive, that the apparent discontinuities in the distribution of these abyssal forms are significant in that they may represent a real absence of the species under certain hydrological conditions; but are fortuitous in that the depths of the stations examined have happened to be such that all the specimens from the same geographical region have come from the same hydrological conditions. It seems possible for example that stations in deeper parts of the sub-Antarctic (say in the South Indian Ocean) might yield samples of the fauna of the Antarctic bottom water, thus filling the geographical gap between the Antarctic and Atlantic records of these species. This would also show that, as might be expected, the change in the abyssal fauna at the Antarctic convergence is less simple than it appears to be in Table 3 A.

Thus, although no conclusions can be drawn from the very scanty faunal data at present available, there appear to be distinct indications that interesting results may be obtained when further collecting can be done in the abyssal regions.

Table 4 shows the distribution, in relation to depth, of the species from the Patagonian and Magellanic regions, the stations being arranged in order of mean depth. The species form three groups: (I) shallow-water species, not found below 118 m.; (II) species found at all depths; (III) species only found below 200 m. As the deepest station is at only 415 m., group III does not represent an abyssal fauna, or anything approaching it, but it does comprise species that have not been found on the continental shelf, which is at about 180 m. Fig. 60 shows the distribution of these stations in relation to the 200 m. line.

It is striking that, with two exceptions, the species restricted to the deeper water are new species and varieties. Of the two known forms, *Amastigia crassimarginata* has not been recorded elsewhere, and has no obviously near relative; *A. gaussi* is otherwise restricted to Antarctic waters; and three of the other four species in group III and the last two species in group II appear to have Antarctic affinities as the following analysis

<sup>1</sup> I have been unable to ascertain the bottom temperatures at the Siboga stations, but the Snellius Expedition took temperatures in the same region (Riel, 1934). These were published in the form of potential temperatures in which allowance was made for compression (Riel, 1934, p. 11). The following Snellius sections give some idea of probable conditions at two of the Siboga stations:

Section 21, Riel, p. 43 (for Siboga St. 211, south of Celebes), potential temperature at 1100 m. a little above 4.0° C.

Section 25 (Indian Ocean end), Riel, p. 47 (for Siboga St. 295, south of West Timor), potential temperature at 2000 m. about 2.35° C.

Section 28, Riel, p. 51, passes through the region of Siboga St. 170, between New Guinea and Ceram, but the temperatures are only given from 1200 m. downwards.

Table 4. Distribution according to depth of the Cellularine Polyzoa collected during the Discovery Investigations in the Magellanic and Patagonian regions, including the Falkland Islands

The stations are shown on the map (text-fig. 60). Challenger St. 320, which is also included, is off the map to the north-east in 37° 17' S, 53° 52' W.

Mean depth in metres	Station	I. Shallow water fauna										II. Species with a wide depth distribution							III. Species only found off continental shelf										
		<i>Scrupocellaria ornithorhynchus</i>	<i>Aetea anguina</i>	<i>Amastigia vibraculifera</i>	<i>Beania fragilis</i>	<i>Beania costata</i> var. <i>maxilla</i>	<i>Beania inermis</i> var. <i>unicornis</i>	<i>Bicellaricella</i> sp.	<i>Scruparia ambigua</i>	<i>Beania costata</i>	<i>Amastigia nuda</i>	<i>Meuipea patagonica</i>	<i>Beania inermis</i>	<i>Tricellaria aculeata</i>	<i>Beania magellanica</i>	<i>Caberea darwini</i>	<i>Amastigia benemunia</i>	<i>Meuipea flagellifera</i>	<i>Notoplites elongatus</i> var. <i>calveti</i>	<i>Himantozoum obtusum</i>	<i>Camptoplites atlanticus</i>	<i>Cornucopina ovalis</i> var. <i>versa</i>	<i>Amastigia gausi</i>	<i>Caberea darwini</i> var. <i>guntheri</i>	<i>Camptoplites bicornis</i> var. <i>quadriangularis</i>	<i>Camptoplites asymmetricus</i>	<i>Amastigia crassimarginata</i>		
1	53	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
1½	58	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
2½	724	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
13	56	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	
27	1230	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
32½	222	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
45	1902	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
53½	WS 847	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
64	WS 836	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
66	1321	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
74½	WS 84	.	+	+	+	.	+	.	.	.	.	.	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	
77	WS 755	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	
79	WS 85	.	.	.	+	+	+	.	.	.	.	.	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	
81½	WS 81	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	
83½	WS 221	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
95	WS 72	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
103	WS 776	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
103	WS 222	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
106½	WS 220	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
108½	WS 95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
110	48	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
110	51	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
111	WS 87	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
115½	WS 765	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
118	WS 88	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
121	388	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
124½	WS 794	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
125½	WS 73	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
131½	WS 93	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
131½	WS 79	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
132	1909	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
133	WS 83	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
139½	WS 825	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
141½	WS 824	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
142	WS 82	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
142½	WS 243	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
148	WS 781	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
149	WS 86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
153½	WS 838	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
154	WS 80	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
155	WS 783	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
161½	WS 225	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
163	WS 231	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
166	WS 249	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
167	WS 784	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
170	652	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
172	WS 247	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
194½	WS 239	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
203	WS 237	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
206	WS 76	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
232½	WS 228	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
237½	WS 246	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
240½	WS 229	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
250	WS 244	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
293½	WS 773	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
315	WS 245	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
338½	WS 871	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
415½	WS 840	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1098	Chall. 320	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

L. Lower limit of shallow water fauna.

S. Approximate level of continental shelf.

\* The three doubtful specimens of *Cornucopina ovalis* var. *versa* were without avicularia, see p. 404.



shows. The presence of three species of the typically Antarctic genus *Camptoplites* (see p. 492) is in itself significant.

*Camptoplites bicornis* var. *quadriavicularis* is also found at the Shag Rocks, near South Georgia which has a predominantly Antarctic Polyzoan fauna (see below). The three other varieties of *C. bicornis* are Antarctic, and the typical form came from an abyssal station in the Antarctic region.

*C. asymmetricus* is also found at South Georgia, and in the deeper water on the Chilean coast (see below). Its nearest relative, *C. areolatus*, is Antarctic.

*Caberea darwinii* var. *guntheri* is not known elsewhere, but resembles the Antarctic form of *C. darwinii*, in contrast to the shallow-water Falkland specimens which represent the extreme sub-Antarctic type of the species (see p. 386).

*Cornucopina ovalis* var. *versa*, on the other hand, shows definite affinities outside the Antarctic, for, although the typical form is found at South Georgia, their nearest relative appears to be the Victorian *C. grandis*. The variety is known from Kerguelen where it was found in 36½ m. and may perhaps have been found in the Straits of Magellan (see p. 403).

*Camptoplites atlanticus* and *Himantozoum obtusum*, both of which extend into rather more shallow Falkland waters, are not found elsewhere, but they, too, are related to Antarctic species, *Camptoplites latus* and *Himantozoum antarcticum* respectively.

*Notoplites elongatus* var. *calveti* comes next to these forms in order of depth and extends into shallow water. The typical form is known from Kerguelen and Marion Island where it forms part of a fauna with sub-Antarctic rather than Antarctic affinities (see p. 484).

There is some evidence that the bottom water off the Patagonian Shelf may in part be of Antarctic origin and character. A branch of the current of Antarctic surface water from the Bellingshausen Sea is known to turn north towards the Falkland Islands and, having sunk below the sub-Antarctic surface water at the Antarctic convergence, to travel north, mixing with the lower layers of the Falkland current, which is a northward current of sub-Antarctic surface water along the coast of Patagonia. (Information obtained, about 1936, through Mr Clowes, from Dr Deacon's unpublished results. Also see Deacon, 1937, pp. 32, 33, 51.)

On the other hand, one of the species with Antarctic affinities (*Camptoplites asymmetricus*) was also found on the Chilean coast where there is not such a strong northward flow of Antarctic water. The specimen was obtained in 320 m. in one of the channels between the islands and the mainland (Challenger St. 308). I am indebted to Dr Deacon for information about the hydrological conditions in this region.

Table 5 shows the species from South Georgia similarly tabulated in relation to depth. It is less complete than Table 4, being based on little more than half the number of stations, and, although there are very nearly as many stations from 190 m. downwards, the 300–400 m. zone is untouched, so that a fair comparison can hardly be made. To emphasize the Antarctic nature of the South Georgian fauna as a whole, Antarctic species are marked A, and those whose nearest relative is Antarctic are marked A\*. The exclusively shallow-water fauna comprises a single species, *Menipea patagonica*, which is chiefly found in the sub-Antarctic.

Table 5. *Distribution according to depth of the Cellularine Polyzoa collected during the Discovery Investigations at South Georgia and the Shag Rocks*

Mean depth in metres	Station	<i>Menipea patagonica</i>	<i>Caberea darwini</i>	<i>Notoplites drygalskii</i>	<i>Himantozoum antarcticum</i>	<i>Anastigia gausi</i>	<i>Camptoplites reiformis</i>	<i>Camptoplites tricornis</i>	<i>Cornucopina polymorpha</i>	<i>Cornucopina pectogemma</i>	<i>Beania erecta</i> var. <i>livingstonei</i>	<i>Farcinellum antarcticum</i>	<i>Camptoplites latus</i> var. <i>aspera</i>	<i>Camptoplites giganteus</i>	<i>Notoplites antarcticus</i>	<i>Notoplites crassiscutus</i>	<i>Beania erecta</i>	<i>Cornucopina ovalis</i>	<i>Camptoplites bicornis</i> var. <i>quadrivicularis</i>	<i>Notoplites tenuis</i>	<i>Camptoplites bicornis</i> var. <i>magna</i>	<i>Camptoplites asymmetricus</i>	
		A	A	A	A	A	A	A	A	A	A	A	A	A*	A	A	A	A	A*	A	A	A	A*
2	WS 56	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
11	MS 64	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
22½	WS 25	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
30½	145	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
39	MS 65	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
48½	WS 177	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
85	MS 71	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
106	153	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
107	WS 27	.	+	+	+	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
110	27	.	.	+	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
129	140	.	+	+	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.
130	WS 33	.	+	+	+	.	+	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.
140	148	.	+	+	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.
150	MS 14	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	159	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
162	42	.	+	+	+	+	+	+	.	+	+	+	.	.	+	+	.	.	.	.	.	.	.
166½	144	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
177	160	.	+	.	.	.	.	+	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.
S 198	WS 42	.	+	.	+	+	+	+	.	+	.	+	+	.	+	.	.	.	.	.	.	.	.
199	474	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
200	20	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
207	39	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.
217	149	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
218	156	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
233½	MS 68	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
240	123	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
245	152	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
254	45	.	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
406	148	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.

A. Species and varieties also known from within the Antarctic circle.

A\*. Species and varieties whose nearest relative is found within the Antarctic circle.

S. Approximate level of continental shelf.

The collections also comprised material from localities outside the Antarctic and sub-Antarctic areas, as follows:

CAPE VERDE ISLANDS	NEW ZEALAND ( <i>cont.</i> )
<i>Bugula dentata</i>	<i>Scrupocellaria ornithorhyncus</i>
ASCENSION ISLAND	<i>Canda arachnoides</i>
<i>Aetea curta</i>	<i>Caberea boryi</i>
<i>Scrupocellaria frondis</i>	<i>C. helicina</i>
SOUTH AFRICA	<i>C. darwinii</i> ( <i>minima</i> -type)
<i>Menipea crispa</i>	<i>C. glabra</i>
<i>M. triseriata</i>	<i>C. angusta</i>
<i>Bugula calathus</i>	<i>C. rostrata</i>
QUEENSLIFFE JETTY, PORT PHILLIP, VICTORIA	<i>Synnotum aegyptiacum</i>
<i>Scrupocellaria ornithorhyncus</i>	<i>Cornucopina zelandica</i>
<i>Scruparia ambigua</i>	<i>C. moluccensis</i> <sup>1</sup>
<i>Aetea anguina</i>	<i>Beania discodermiae</i> <sup>1</sup>
NEW ZEALAND	<i>B. pulchella</i>
<i>Anastigia harmeri</i>	<i>B. intermedia</i> <sup>1</sup>
<i>Menipea zelandica</i>	<i>Bugula expansa</i> Hastings (1939, p. 338) <sup>1</sup>
<i>M. vectifera</i>	<i>B. cucullata</i> var. <i>cuspidata</i>
<i>Tricellaria monotrypa</i>	<i>Caulibugula tuberosa</i>
<i>Emma triangula</i>	<i>Dimetopia cornuta</i> Busk (1852 a, p. 384) <sup>1</sup>
	<i>Scruparia ambigua</i>

Some of these species are also known from the sub-Antarctic region, namely, *Aetea curta*, *Scrupocellaria ornithorhyncus*, *Caberea darwinii*, *C. rostrata* and *Scruparia ambigua* (see Table 3, p. 479).

#### THE RELATION BETWEEN HYDROLOGICAL CONDITIONS AND THE DISTRIBUTION OF THE SPECIES

The outstanding feature of the foregoing discussion is the correlation of the distribution of the species with hydrology. The abundant collections of specimens, and the fine and comprehensive analysis of the hydrology provided by the Discovery Investigations give an unusual opportunity of testing this relationship. My results are, for reasons explained on p. 477, incomplete and tentative, but I think they are very suggestive.

Among the Antarctic and sub-Antarctic Cellularine Polyzoa we have several instances of apparent correlation:

(1) The decisive influence on the non-abyssal fauna of the change in hydrological conditions at the Antarctic convergence which is demonstrated by Table 3 (p. 479).

(2) The presence of a fauna with Antarctic affinities in a zone off the Patagonian shelf probably influenced by Antarctic water, demonstrated in Table 4 (p. 487).

(3) The possible relation of the distribution of the abyssal species to the warm and cold deep currents (p. 486).

On the other hand, the fauna of Heard Island is similar to that of the other islands in the South Indian Ocean despite its different hydrological conditions (see p. 483).

In the distribution of plankton the very close correlation with hydrological conditions is well known, and, among free-swimming animals, the distribution of the fishes has been found to correspond very closely with the temperature of the water (Norman, 1931,

<sup>1</sup> Collected by the Terra Nova Expedition, not obtained by the 'Discovery'. For those not discussed elsewhere in this report a reference is given.

p. 255). The restriction of bottom-living animals to particular habitats in more or less limited regions has been shown by various ecological surveys; but I think the possibility of a close correlation with hydrology of the wider geographical distribution of a group, whose members are not only bottom-living but fixed, has not been generally recognized. Detailed analysis of this relationship might explain some of the apparent anomalies of distribution.

#### DISTRIBUTION OF THE GENERA

From Table 3 (p. 479) we see that fourteen genera of Cellularine Polyzoa are represented in the hydrologically Antarctic region south of the Antarctic convergence.

Two of these (*Tricellaria* and *Menipea*) are represented by only two species, and only penetrate the northern part of the Antarctic area. *Bugula*, which otherwise has an almost world-wide distribution, is represented in the Antarctic area by a single rather aberrant species, *B. longissima*. The genus is also almost completely absent from sub-Antarctic waters, *B. hyadesi* being the only species recorded.

Consideration of the distribution of *Brettia* and the two new genera, *Klugella* and *Erymophora*, must wait till further revision of other faunas gives us a reliable list of the species to be included.

This leaves eight Antarctic genera whose distribution can profitably be discussed. Six of these, *Amastigia*, *Notoplites*, *Farciminellum*, *Cornucopina*, *Himantozoum* and *Camptoplites*, are predominantly Antarctic and sub-Antarctic. The other two, *Beania* and *Caberea*, are distributed almost throughout the world. *Beania* has several sub-Antarctic species, and two Antarctic ones, namely, *B. erecta*, which is common, and *B. scotti*, known from a single fragment. *Caberea* is represented in our area by a single, widely distributed, variable species, *C. darwinii* (see p. 382), and by *C. rostrata* which is found at Tristan and New Zealand.

The distribution of the six predominantly Antarctic genera is summarized in the maps (Figs. 61-66). The numbers on the maps represent the number of species recorded from each locality. Species from depths greater than 1000 m. are indicated by figures on black circles. A list of the species that I have included in the genus is given with each map, with a reference to the page in the report where the distribution of each species is to be found. Where the distribution is not included in this report a reference is given.

In each genus we find at least one species that is very widely distributed in the Antarctic, at least one shallow-water sub-Antarctic form, and a few deep-water species extending farther north, particularly in the Atlantic and the Malay Archipelago. This completes the story of the distribution of *Camptoplites*,<sup>1</sup> but the other genera are more widely dispersed. *Notoplites*, which is found in deep water in the Atlantic, appears again in shallow boreal and Arctic waters, and *Amastigia* is known from South Africa; but only three<sup>2</sup> species in all the six genera are recorded in shallow water from America

<sup>1</sup> See Addendum, p. 501.

<sup>2</sup> Including *Cornucopina antillea* Osburn from 732 m.





Fig. 61. Map to show the distribution of the genus *Camptoplites*, based on distribution of: *C. abyssicolus* (Kluge), p. 452; *C. angustus* (Kluge), p. 453; *C. areolatus* (Busk), p. 466; *C. asymmetricus* sp.n., p. 466; *C. atlanticus* sp.n., p. 460; *C. bicornis* (Busk) and vars., pp. 443-449; *C. giganteus* (Kluge), p. 451; *C. latus* (Kluge) and vars., p. 458; *C. levaldi* (Kluge), p. 449; *C. lunatus* Harmer, p. 464; *C. rectilinearis* sp.n., p. 462; *C. reticulatus* (Busk) and var., p. 463; *C. retiformis* (Kluge) and var., pp. 453, 455; *C. tricornis* (Waters), p. 451.



Fig. 62. Map to show the distribution of the genus *Farciminellum*, based on distribution of: *F. alicae* (Jullien & Calvet), see Harmer, 1926, p. 405; *F. antarcticum* sp.n., p. 391; *F. atlanticum* (Busk), see Harmer, 1926, p. 405; *F. hexagonum* (Busk), p. 393; *F. lineare* (Kluge), p. 393. The depth at which *F. hexagonum* was obtained at the Andaman Islands is not recorded.

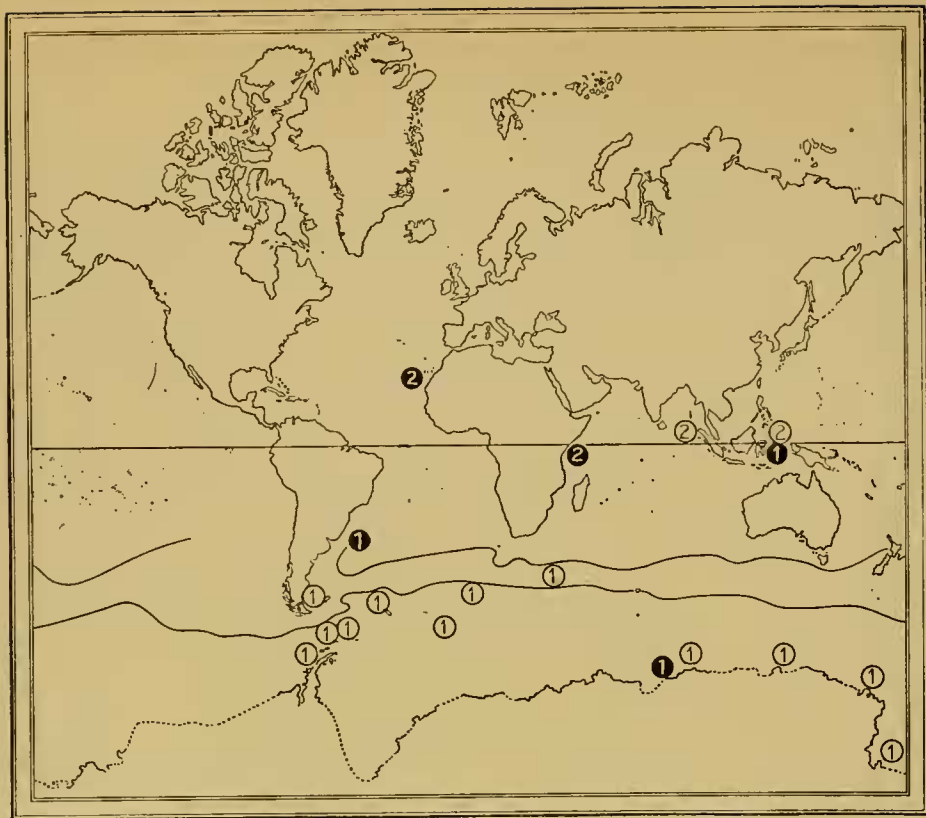


Fig. 63. Map to show the distribution of the genus *Himantozoum*, based on distribution of: *H. antarcticum* (Calvet), p. 422; *H. apsteini* (Hasenbank, 1932, p. 333); *H. emaciatum* Harmer, 1926, p. 455; *H. hessei* (Hasenbank, 1932, p. 331); *H. leontodon* (Busk) and var., see Hasenbank, 1932, p. 335; *H. margariferum* (Busk, 1884, p. 41); *H. mirabile* (Busk, 1884, p. 39); *H. obtusum* sp.n., p. 424; *H. sinuosum* (Busk) and var., pp. 425, 426; *H. taurinum* Harmer, 1926, p. 454.



Fig. 64. Map to show the distribution of the genus *Cornucopina*, based on distribution of: *C. angulata* (Kluge), p. 406; *C. bella* (Busk); *C. conica* Harmer, p. 398; *C. geniculata* Harmer; *C. grandis* (Busk); *C. infundibulata* (Busk), p. 399; *C. lata* (Kluge), p. 402; *C. moluccensis* (Busk), p. 406; *C. navicularis* (Busk), p. 406; *C. ovalis* sp.n. and var., pp. 402, 404; *C. pectogemma* (Goldstein), p. 397; *C. polymorpha* (Kluge), p. 399; *C. rotundata* (Kluge), p. 407; *C. tuba* (Busk); *C. zelandica* sp.n., p. 405. For species for which no page is given see Harmer (1926, pp. 422-8).

Since the block was made for this map I have seen Osburn's paper on *Cornucopina antillea* from 732 m. in the West Indian region (see p. 398).

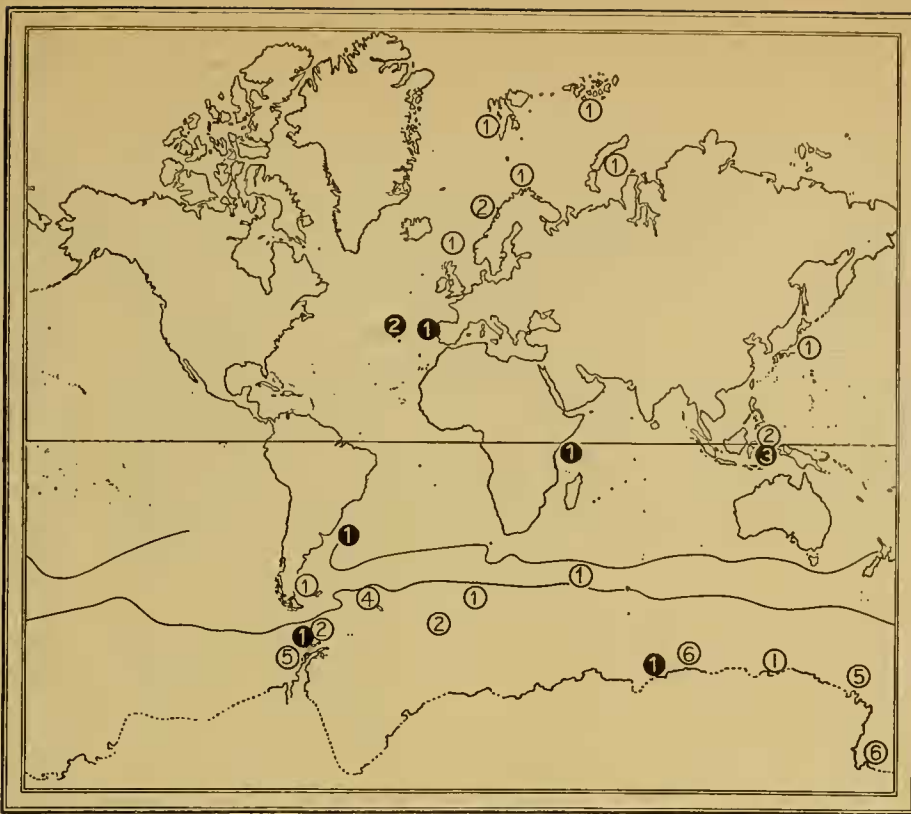


Fig. 65. Map to show the distribution of the genus *Notoplites*, based on distribution of: *N. antarcticus* (Waters), p. 341; *N. aviculariae* (Yanagi and Okada); *N. biloba* (Busk); *N. crassiscutus* sp.n., p. 353; *N. crateriformis* (Busk); *N. drygalskii* (Kluge), p. 342; *N. elongatus* (Busk) and var., pp. 346, 348; *N. impar* Harmer, 1926, p. 354; *N. jeffreysii* (Norman); *N. klugei* (Hasenbank), p. 352; *N. marsupiatius* (Jullien); *N. normani* (Nordgaard); *N. obliquidens* Harmer, 1926, p. 355; *N. perditus* (Kluge), p. 355; *N. rostratus* Harmer, 1926, p. 352; *N. scutatus* Harmer, 1926, p. 353; *N. smittii* (Norman); *N. tenuis* (Kluge) and var., pp. 350, 351; *N. undulatus* Hasenbank, 1932, p. 371; *N. vanhoeffeni* (Kluge), p. 346; *N. watersi* (Kluge), p. 342. For species for which neither reference nor page is given see Harmer (1923, pp. 350-3).



Fig. 66. Map to show the distribution of the genus *Amastigia*, based on distribution of: *A. abyssicola* (Kluge), p. 331; *A. antarctica* (Kluge), p. 329; *A. benemunita* (Busk), p. 325 (record near southern end of Chilean coast, Challenger St. 308, accidentally omitted); *A. cabereoides* (Kluge), p. 327; *A. crassimarginata* (Busk), p. 331; *A. funiculata* (MacGillivray), see Harmer, 1923, p. 335; *A. gausi* (Kluge), p. 323; *A. harmeri* sp.n., p. 322; *A. kirpatricki* Harmer, p. 327; *A. nuda* Busk, p. 321; *A. pateriformis* (Busk), p. 330; *A. rudis* (Busk), see Harmer, 1923, p. 332; *A. solida* (Kluge), p. 330; *A. vibraculifera* sp.n., p. 327; *Amastigia* sp. (A specimen of an undescribed species from Japan, 62.7.16.69.)

north of the sub-Antarctic, whereas there are eight from the Malay Archipelago, five from Australia, four from New Zealand and three from Japan.<sup>1</sup> *Caberea* and *Beania* are more widely distributed, but both have their greatest concentration of species in the Australasian region. Information from other groups is scanty. John (1937, p. 87) found South American affinities for the Antarctic Echinoderms, but the few other groups for which I have comparable data<sup>2</sup> seem to show the same tendency as the Polyzoa, the northward part of their range extending around the Australasian and eastern Asiatic land masses rather than around the American continent.

Table 6 summarizes the distribution of the recent species of the six predominantly Antarctic genera of Cellularine Polyzoa.

Table 6. *Summary of the distribution of the recent species of the six predominantly Antarctic genera of Cellularine Polyzoa*

The figures indicate the number of species recorded from each locality. Those in heavy type were taken at depths greater than 1000 m.

	Additional localities	North Atlantic	Tropical America (east coast)	Off subtropical South America	Sub-Antarctic	Antarctic (Weddell Quadrant)	Antarctic (Victoria Quadrant)	Indian Ocean	New Zealand	Australia	Malay Archipelago	Japan
<i>Camptoplites</i>		.	.	<b>I</b>	3+2	8	9+2	.	.	.	<b>I</b>	.
<i>Farciminellum</i>		<b>I</b>	<b>I</b>	.	<b>I</b>	<b>I</b>	<b>I+I</b>	<b>I</b>	.	.	<b>I</b>	.
<i>Himantozoum</i>		<b>2</b>	.	<b>I</b>	<b>2</b>	<b>I</b>	<b>I+I</b>	<b>2+2</b>	.	.	<b>2+I</b>	.
<i>Cornucopina</i>		.	<b>2</b>	<b>I</b>	<b>2+2</b>	<b>3</b>	<b>3+3</b>	<b>I</b>	<b>2</b>	<b>2</b>	<b>3+3</b>	.
<i>Notoplites</i>	Arctic	<b>2</b>	<b>2+2</b>	.	<b>I</b>	<b>7+I</b>	<b>6+I</b>	<b>I</b>	.	.	<b>2+3</b>	<b>I</b>
<i>Amastigia</i>	S. Africa	<b>I</b>	.	.	<b>I</b>	<b>6</b>	<b>I+I</b>	<b>4+I</b>	.	<b>2</b>	<b>I</b>	<b>2</b>

The Polyzoa of Australasia and the Malay Archipelago have been much more intensively studied than those of South America, although the Central and North American Polyzoa are relatively well known, and the rarity of species of these Antarctic genera in South American waters may thus only be apparent. If it were a real peculiarity of distribution it could only be explained in relation to the geological history of the region and of the genera. Unfortunately, the Cellularine Polyzoa are not commonly preserved as fossils, owing to their delicate structure. Canu's papers on fossils from the Argentine (Canu, 1908, 1911) do not include any Cellularina, but a number of species are described from the Tertiary beds of Australia and New Zealand by MacGillivray, Waters and Maplestone. Mostly they are difficult to place generically, but typical species of *Amastigia* and *Caberea* are recognizable amongst them. For instance, *Menipea lineata* MacGillivray

<sup>1</sup> See Addendum, p. 501.

<sup>2</sup> Serolidae (Sheppard, 1933, p. 264), *Cephalodiscus* (John, 1931, pp. 256-259), Nototheniiformes (Norman, 1938, p. 95).

(1895) and *Scrupocellaria glomerata* Maplestone (1900) both appear to belong to *Amastigia* as now understood. *A. acuminata* Maplestone (1900), on the other hand, appears to be wrongly attributed to the genus.

### SEASONAL DISTRIBUTION OF ANCESTRULAE

Quite a large number of ancestrulae have been mentioned in this report, and the idea at once comes to mind that some evidence of the extent of the breeding period might be obtained from them, for the Cellularine ancestrulae soon break away or become enveloped in rootlets, and are therefore usually only found on small, young colonies.

Tables 7 A and B summarize the facts obtained from the collections of Antarctic and sub-Antarctic material examined by me.

The tables are based on the three big collections which I myself have examined, namely, the collections of the Discovery, the National Antarctic and the Terra Nova expeditions. I do not claim to have found all the ancestrulae, nor even to have searched for them specially, but I have picked over the whole of the material for other purposes, and every ancestrula noticed has been preserved. Thus the tables can be regarded as based on a fairly uniform sampling of the material. They are, however, inconclusive for various reasons.

In the first place it must be remembered that the ancestrulae are known in only a small proportion of species. Further, it is immediately evident that the abundance of ancestrulae reflects to some extent the intensity of collecting, as indicated by the number of stations per month yielding adult colonies. The average number of ancestrulae per station shows some increase in the warmer months, but this may be due to the chances of a single rich haul. Nearly all the January Antarctic records came from four stations, two of which were made within four days of each other in the Ross Sea; and more than half the February Antarctic records were from a single station (St. TN 194).

Nevertheless, there appears to be a distinct tendency in the Antarctic for the ancestrulae only to be found in January, February or March, although adult colonies of the species were collected over a period of 4-7 months. In view of the factors just discussed, I am not sure, however, that this appearance is statistically significant, especially as the few ancestrulae of known date that have been recorded from other collections extend the seasonal range of the ancestrulae as follows:

*Camptoplites* 4 (*Bugula reticulata* var. *spinosa* Waters, figured), Bellingshausen Sea, 18 October 1898.

*Camptoplites* sp. (*Bugula reticulata* var. *spinosa* Waters, unfigured), Bellingshausen Sea, 20 December 1898.

*Camptoplites areolatus* (var. *variospinosa* Kluge), Gauss-station, 24 April 1902.

*Camptoplites* 3 (*Bugula multispinosa* Kluge), Gauss-station, 14 June 1902.

These ancestrulae (which are discussed on pp. 436-441) have been omitted from the table in order that the data given may be based entirely on my sampling and so have, as far as possible, a uniform statistical value.

The stragglers in the sub-Antarctic table may be misleading. The ancestrulae of

Table 7. Seasonal distribution of Ancestrulae in the Discovery, National Antarctic and Terra Nova Collections

	No. of stations at which adults were taken	No. of stations at which ancestrulae were taken	Months in which species were collected. Where ancestrulae were taken their number is given. A cross means that only adult colonies were obtained											
			IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII
A. Sub-Antarctic														
<i>Menipea flagellifera</i>	23	2	.	.	.	.	+	+	+	2	.	+	+	.
<i>Notoplites elongatus</i>	2	1	.	.	.	.	.	.	.	1	.	.	.	.
<i>Tricellaria aculeata</i>	20	1	.	.	+	+	.	+	1	+	+	+	+	.
<i>Caberea darwini</i>	22	4	+	.	+	.	.	+	+	13	+	+	+	.
<i>Caberea rostrata</i>	3	1	.	.	2	.	+	.	.	.	.	.	.	.
<i>Beania costata</i> var. <i>maxilla</i>	1	1	.	.	.	.	.	.	1	.	.	.	.	.
<i>Camptoplites 2</i> ( <i>C. atlanticus</i> )	4	1	.	3	.	.	+	.	.	+	.	.	+	.
<i>Scruparia ambigua</i>	4	1	.	.	+	.	.	8	.	+	.	.	.	.
Unnamed ancestrulae	.	6	.	.	1	.	.	1	.	3	.	.	1	.
Number of ancestrulae per month			.	3	3	.	.	9	2	19	.	.	1	.
Stations per month yielding ancestrulae			.	1	1	.	.	1	2	4	.	.	1	.
Stations per month yielding Cellularine Polyzoa			1	2	6	4	4	5	13	13	6	6	10	.
B. Antarctic														
<i>Amastigia solida</i>	1	1	.	.	.	.	.	1	.	.	.	.	.	.
<i>Notoplites antarcticus</i>	1	3	.	.	.	.	3	+	2	+	.	.	.	.
<i>Notoplites drygalskii</i>	34	1	.	.	+	+	+	3	+	+	.	.	.	.
<i>Notoplites tenuis</i>	18	8	.	.	.	.	20	2	9	.	.	.	.	.
<i>Caberea darwini</i>	27	6	.	.	.	1	2	4	+	1	.	.	.	+
<i>Cornucopina pectogemma</i>	9	1	.	.	.	+	+	2	+	+	.	.	.	.
<i>Cornucopina polymorpha</i>	13	1	.	.	.	+	+	+	2	.	.	.	.	.
<i>Beania erecta</i>	8	1	.	.	.	.	1	+	+	.	.	.	.	.
<i>Himantozoum antarcticum</i>	25	2	.	+	+	+	7	2	+	+	.	.	.	.
<i>Camptoplites 5</i> ( <i>C. retiformis</i> )	17	2	.	.	.	+	3	+	+	.	.	.	.	.
<i>Camptoplites 6</i> ( <i>C. angustus</i> )	9	3	.	.	.	.	2	+	3	.	.	.	.	.
<i>Camptoplites 7</i> ( <i>C. bicornis</i> var. <i>elator</i> )	4	2	.	.	.	.	+	1	1	.	.	.	.	.
<i>Camptoplites 1</i>	.	2	.	.	.	.	4	.	.	.	.	.	.	.
<i>Camptoplites 3</i>	.	4	.	.	.	.	3	.	1	.	.	.	.	.
<i>Camptoplites 4</i>	.	2	.	.	.	.	.	.	3	.	.	.	.	.
Unnamed ancestrulae	.	5	.	.	.	.	3	1	.	.	.	.	.	.
Number of ancestrulae per month			.	.	.	1	48	16	21	1	.	.	.	.
Stations per month yielding ancestrulae			.	.	.	1	7	3	7	1	.	.	.	.
Stations per month yielding Cellularine Polyzoa			2	1	4	5	29	15	19	3	1	1	.	2

*Camptoplites* 2 taken in October and the unnamed ancestrula taken in July were obtained from stations beyond the edge of the continental shelf (Sts. WS 773 and WS 237), where seasonal influences must be different; and the November ancestrulae came from Tristan da Cunha at the northern limit of the sub-Antarctic area (see p. 484). The tendency for the ancestrulae in typically sub-Antarctic localities to be found in February, March and April may thus be more definite than appears, at first sight, from the table.

On the other hand, the collecting chances have influenced this table even more than the Antarctic one, for eighteen of the nineteen April ancestrulae were collected on a single day at Marion Island and Prince Edward Island (Sts. 1562, 1563, 1564).

An ancestrula of *Beania costata* in the U.S. National Museum's Falkland Collection was taken on 22 April 1927, but is not included in the table.

#### NOTE ON THE VERMIFORM BODIES FOUND IN SOME POLYZOA

Bodies of various types have frequently been observed in the body-cavity of the Polyzoa and described as "gland-like bodies", "vermiform bodies", "enigmatic bodies", "sausage-like bodies", etc. They probably comprise more than one type of structure.

There are, for instance, the paired organs, placed one on each side of the operculum, usually known as opercular glands. Harmer (1926, p. 480) noted that these organs appear to open into the vestibule and might possibly be testes (as suggested by various authors), poison glands, slime glands or excretory organs. The median gland-like structure in *Cigclisula* (see *Lepralia oclusa* Waters, 1909, p. 152, *Cigclisula cautium* Hastings, 1932, p. 435) seems to be of the same type.

Others do not have any apparent connexion with the vestibule and orifice. They may be paired or unpaired, and, within the species, may be fairly constant in form and position, or very variable. It is not certain that they are all of the same nature and some may even be parasites. Their nature could probably only be determined by examination of fresh and specially preserved material, which is not possible at present (March, 1941). It may, however, be useful to remind workers of the existence of this problem, and to set down the main facts at present known.

Busk (1884, p. 58) described "bands" in the zooecia of specimens of *Carbasea pisciformis* from Bass Strait. He described them as thick-walled epithelial tubes closed at both ends. He could discover nothing about the contents of the tubes. He regarded them as part of the Polyzoa and distinguished them from the "parasitic vermicules" which he also found. They are clearly visible in a slide made from his material (87.12.9.281)<sup>1</sup> and are very constant in their position, lying one on each side of the zooecium, close to the lateral walls and extending the whole length of the zooecium. Busk compared them to the horseshoe-shaped body which he described in *Onchoporoides moseleyi*. Unfortunately, no material of this species is accessible to me at present,<sup>1</sup> and it is some years since I examined it. My recollection is, however, that these

<sup>1</sup> Busk's own slides of *Carbasea pisciformis* and *Onchoporoides moseleyi* have been sent out of London for safety.

horseshoe-shaped structures are incipient ovicells. In any case it appears from Busk's description of them as cavities in the calcareous frontal wall that they are very different in nature from the bands in the body-cavity of *Carbasa pisciformis*.

Waters (1904, p. 21) described a pair of vermiform bodies in one of the varieties of *Camptoplites bicornis*. (Kluge has shown that *Bugula bicornis* Waters comprised three varieties, but not the typical form; see Kluge, 1914, pp. 619, 622, 623 for synonymy.) Waters described them as arising from the frontal membrane and regarded them as part of the Polyzoan, and "undoubtedly equivalent to the gland-like body" to which he had frequently referred. His paper on gland-like bodies (1892) does not, however, show anything very much like them, and chiefly describes undoubted organs of the Polyzoa such as the paired opercular glands and the vestigial polypides of avicularia. In 1909 (p. 132) and 1913 (pp. 474, 476) Waters recorded similar vermiform bodies in various members of the Scrupocellariidae and regarded them as in some way to do with the testis.

Palk (1911), working at Naples, described similar bodies in *Carbasa papyrea* (Pall.) which she treated as synonymous with *C. carbasa* Ell. & Sol. They were attached by one end to the frontal membrane "outside the occlusor muscles", and were very variable in shape, being variously coiled, looped and sometimes constricted. She found something in the nature of an epithelial wall and a coiled, thread-like contents to the tube. In mass the threads suggested spermatozoa, but when teased out they appeared to form a continuous cord with darkly staining dots at intervals. The vermiform bodies were present in zooecia both with and without spermatid tissue, and were largest in those with brown bodies.

In external appearance Palk's bodies closely resemble those that I have found in several species of Antarctic Polyzoa, but I have no reason to think that my material has the thread-like internal structures. I have not, however, cut sections, and the material was preserved in spirit without special fixation.

In the collections discussed in this report I have noted the presence of vermiform bodies in the zooecia of some specimens of *Notoplites drygalskii*, *N. vanhoeffeni*, *N. tenuis*, *Menipea flagellifera*, *Camptoplites giganteus* and *Beania magellanica*. They are not to be seen in every zooecium nor in every specimen. Except in *B. magellanica*, where their position is relatively constant, they do not appear to have an exactly fixed position in the zooecium.

In *B. magellanica* they are short and lie one on each side of the polypide at about the middle of the length of the zooecium, one frequently being a little more distally placed than the other.

Those that I have seen in *Menipea flagellifera* are single and stout, very irregularly placed in the zooecium and variously coiled.

In one specimen of *Notoplites tenuis* single, straight, rather stout bodies are to be seen in zooecia in which the body cavity contains great quantities of spermatid tissue, and in another specimen single ones of similar form are present in zooecia with brown bodies or with polypide buds.

In *N. drygalskii* and *N. vanhoeffeni* they may much resemble those shown in Palk's



fig. 1 or, more commonly, the two lateral bands may be continuous proximally forming a single U-shaped body of considerable length.

In *Camptoplites giganteus* the zooecia may contain single, very long, coiled, almost tangled, bodies, which are more slender and less coarsely granular than those of *Notoplites drygalskii*.

The distribution of the bodies in the colony and their position in the zooecia appear to bear no special relation either to the reproductive phase of the colony or to the state of the polypide. They usually stain less readily than the other tissues with borax carmine.

Except, perhaps, in *Beania magellanica*, they seem to me to suggest parasites rather than organs of the Polyzoa, and I have therefore shown those in *Notoplites drygalskii* to Dr H. A. Baylis and Professor Doris Mackinnon. Both authorities found it impossible to come to any decision about them without fresh, properly fixed material, but both suggested very tentatively that they might perhaps be Protozoa. Dr Baylis reported that they were certainly not worms.

#### ADDENDUM

Dr Silén's paper on *Cheilostomata Anasca* from Japan and the Bonin Islands (Ark. Zool. Stockholm, 33A, 1942) did not reach me till August, 1942, when this report, which was completed in July, 1941, was in page-proof. He describes a new species of *Camptoplites* of the *C. bicornis* group, extending the range of the genus to Japan, and a new species of *Tricellaria* of the *T. sympodia* group.

Professor Marcus's work on *Bryozoa* from Brazil (Bol. Zool. São Paulo, 5, 1941) did not reach me till April, 1943. He discusses the distribution of *Caberea boryi*.

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PLATE V

Figs. 1, 2. *Menipea patagonica* Busk. 1. Bushy colony. St. 145, South Georgia. 2. Feathery colony. St. WS 72, Patagonian Shelf. Both natural size.

Fig. 3. *Menipea zelandica* sp.n. Type-specimen from St. 935, New Zealand. Natural size.

Fig. 4. *Menipea roborata* (Hincks). 50.5.2.2. Australia. Natural size.

Fig. 5. *Menipea zelandica* sp.n. Part of type-specimen. St. 935, New Zealand.  $\times 10$ . The rootlet-chambers are to be seen at the shaded edge of the branch, beside the avicularium of each marginal zoecium, and might be mistaken for a second avicularium.